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ANNUAL REPORT

with respects

OF

CAPTAIN A. A. HUMPHREYS,

TOPOGRAPHICAL ENGINEERS,

IN CHARGE OF

A.S. OFFICE OF EXPLORATIONS AND SURVEYS, WAR DEPARTMENT.

DECEMBER, 1858.

WASHINGTON:
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REPORT FROM THE OFFICE OF EXPLORATIONS AND SURVEYS.

WAR DEPARTMENT, OFFICE EXPLORATIONS AND SURVEYS,
Washington, November 20, 1858.

SIR: I submit the following annual report upon the operations of the department carried on under this office.

I.—THE EXPERIMENT OF SINKING ARTESIAN WELLS UPON THE PUBLIC LANDS.

In my last annual report to the department (November 30, 1857,) it was stated that the expedition to continue the experiment of sinking artesian wells upon the public lands, assigned by the department to Captain John Pope, Topographical Engineers, under instructions of May 5, arrived at the former camp on the Pecos on the 2d of September, 1857, and resumed work upon the well which had been bored to the depth of eight hundred and sixty-one feet the previous year.

The operations at this point were carried on for a year, when they were terminated by authority of the department, it having been considered that they had demonstrated that, with any reasonable amount of expenditure, artesian wells on the Llano Estacado, and plains of similar formation and position, are impracticable. The depth attained was one thousand and fifty feet.

The work was continued during the winter, which, from its unusual severity, increased the labors and hardships of the party, exposed, as it was, in tents on the bleak plain. The difficulties encountered were far greater than had been anticipated by Captain Pope, but were constantly met with skill, zeal, and perseverance.

The impracticability of carrying the boring to a greater depth with the means provided, is attributable to the incoherent nature of the soft sandstones, marls, and clays, which, throughout the whole depth of the well, fell in and packed so firmly around the tubing, that, in forcing it down, the threads of the connecting screws were stripped off, and the tubes themselves split and crushed. From the same cause, when it became necessary to withdraw the tubes upon the accidental loss in the well of the heavy iron rod connected with the cutting tools, and subsequently of the slips holding the cutters, long delays occurred; and in one of these cases the well could only be cleared by boring and spearing up a part of the tubing. Near the bottom of the well thin seams of hard limestone were met, the jagged edges of which cut the wooden rods in two, and bent the iron rods so that they speedily became worthless.

The water used in the boiler of the engine contained material in suspension that formed in six days a hard incrustation half an inch thick, which could only be removed by chiseling. The fine sand in suspension cut away the valves, and the acids in solution rapidly destroyed the boiler and other iron work. Much time was thus lost, and new machinery could not be obtained nearer than New Orleans.

Such, in brief, were the obstacles encountered in sinking the well

to the depth of one thousand and fifty feet; beyond that depth it could not be carried.

Captain Pope expresses the belief that wells might be bored to a much greater depth on the Llano by using heavy cast iron tubes of large diameter, and suitable driving apparatus, but that the cost of transporting this heavy material would preclude its use. Upon this I can express no opinion, as the dimensions, weight, &c., of this tubing are not stated.

The reports received from Captain Pope do not specify how many new supplies of water were met during the last operations. One new supply, described as a strong stream pouring into the well, is marked on the diagram as entering it two hundred feet below the lowest water previously encountered (in 1856,) which, coming from a source six hundred and seventy-six feet below, rose to within one hundred and ten feet of the surface. As it is not stated that the water from this new supply rose higher in the well than during the previous year, it is presumed that it did not. In Captain Pope's letter of the 4th of June, 1858, mention is made of powerful streams of water pouring into the well without rising to the surface. This would indicate that they find vent at lower levels than that of the surface of the Llano at the well, and would lead us to apprehend the same result for streams that might be encountered at greater depths, and to doubt whether the water would flow out at the surface even if the boring were carried to the depth originally intended. Captain Pope does not appear to entertain any such doubt, but, on the contrary, explicitly states in his report of the 22d of August last, that his opinions about the certainty of getting water to overflow at the surface are unchanged.

The suggestions of Captain Pope, in his report of the 4th of June, that the work upon the well near the Pecos should be discontinued, and the next experiment be made upon or near the route between Anton Chico and Albuquerque, were approved by the department, and instructions to that effect were sent him on the 10th of July. At the date of his last communication (September 28) the party had arrived at Galisteo, and commenced the experiment on the plain between Anton Chico and Albuquerque, at the intersection of the road between those two places with the road from Santa Fé to Fort Stanton.

In order to exhibit the nature and extent of the operations of Captain Pope, I submit herewith copies of his instructions and reports of progress. It is only by their perusal that his labors can be properly appreciated.

II.—EXPLORATION OF THE RIO COLORADO OF THE WEST.

The expedition for the exploration of the Rio Colorado of the West, commanded by First Lieutenant J. C. Ives, Topographical Engineers, has completed its field operations. Lieutenant Ives returned to Washington in August, and is now employed in preparing the report and maps. I submit herewith a communication from him, showing briefly a portion of the results of the expedition.

In the last annual report it was stated that the expedition was at

San Francisco, *en route* for the field. The supplies and property of the party, and also the materials for constructing a small iron steamboat, were sent from San Francisco to the mouth of the Colorado in one of the government vessels. They arrived there on the 2d of December. Under serious disadvantages the steamboat was put together, and on the 31st of December the ascent of the river was commenced. On the 11th of March a point was reached nearly five hundred miles from the mouth, (in lat. $36^{\circ} 06'$,) beyond which it was impracticable to proceed in boats. It was intended that the examination of the river should be made in the season of low water, and during the progress of the party the river proved to be lower than had ever been known. In this worst stage the navigation was found to be difficult, but is pronounced entirely practicable, for the distance stated, for steamboats of suitable construction and of but two feet draught. The trip from the mouth to the head of navigation will require from ten to twenty days, and the round trip from three to six weeks. There is an abundance of wood for fuel on the river.

From the head of navigation to the nearest point on the Spanish trail, or Mormon road to Utah, the distance is forty miles; about one hundred miles to the point where that road crosses the Muddy river, a tributary of the Virgen; two hundred and twenty miles to the first Mormon settlement in the Great Salt Lake basin, and five hundred miles to the Great Salt Lake.

The head of navigation is about seventy miles above the Mojave valley.

Examinations should be made for a better route between the head of navigation and the Virgen, since, for the space of sixty miles before reaching the Muddy river, no water is found on the Mormon road.

By using the Colorado as a channel for forwarding supplies, there would be a saving in land transportation to Salt Lake of seven hundred miles; to Fort Defiance of six hundred miles, and to Fort Buchanan of eleven hundred miles.

The chains of mountains that cross the navigable portion of the Colorado were found, like those of California and Sonora, to possess great mineral wealth. Rich deposits of silver, copper, and lead were observed, and a great abundance of iron; but gold and mercury only in small quantities.

After the completion of the reconnaissance of the river, explorations were conducted by land along the 36th parallel, on the plateau region through which the upper Colorado and its tributaries cañon, the greater part of which was entirely unknown. Extending over a space of four degrees of longitude, these plateaus were found cut into immense chasms, thousands of feet deep, forming intricate systems of abysses many miles in width, and utterly impassable. Through these chasms the streams just mentioned ran, and, wherever seen, foamed and surged with the rapidity of their descent.

Near the eastern border of the table lands, which extend from the Colorado to the mountains of the Sierra Madre, the Moquis towns are found. They were visited by the expedition, which arrived at Albuquerque about the 1st of June, and was there broken up.

The region explored is pronounced to be of little agricultural value. Cretaceous coal was found near the Moquis towns.

The examinations of Lieutenant Ives confirm the opinion of Captain Whipple as to the railroad practicability of the line from the Big Sandy to the Colorado river, which is shorter than the line down Bill Williams' Fork by ninety miles, and less costly by six million dollars. The changes effected by the adoption of this line, in the length and cost of the whole route, will be found on pages 36 and 37 of the conclusion of the official review, volume VII of the Pacific Railroad Report. This is the only modification of the railroad route of the 35th parallel introduced by the explorations of Lieutenant Ives and the examinations made by Mr. Beale when opening the wagon road from Fort Defiance to the Colorado river.

The explorations conducted by Lieutenant Ives were attended by circumstances of more than ordinary difficulty, and the successful execution of the duties assigned to him is highly creditable to himself and party.

III.—EXPLORATIONS IN NEBRASKA.

The return, in November last, of the expedition commanded by Lieutenant G. K. Warren, Topographical Engineers, after the successful execution of the duties intrusted to him of reconnaissance and exploration in Nebraska, has been already reported. The maps have been completed, all the necessary calculations of the astronomical and barometrical observations made, and the reports in relation to the different objects of the expedition are in an advanced state.

The principal objects of the expedition were to ascertain the best route by which to continue to the South Pass the military road now constructing from the Mississippi river to Sioux City, on the Missouri, and to examine in this connexion the valley of the Loup Fork of the Platte, and that of the Niobrara, and to make such reconnaissance of the Black Hills about the sources of the Big Shyenne as circumstances would permit, to determine their character, especially with reference to the future military operations that may be carried on in this Territory. In accomplishing these objects, the expedition would obtain information of the character and resources of the country, its adaptability to settlement and cultivation, and would develop its geography and geology along the routes pursued, nearly all of which were previously unexplored by white men.

The preliminary report of Lieutenant Warren is herewith presented. The routes reconnoitred and mapped in 1857 are from Sioux City to the mouth of Loup Fork; thence up this stream to its source in the Sand Hills; and thence by the Niobrara to Fort Laramie. From this point the party proceeded north and carefully examined the Black Hills, and, returning to the Niobrara, explored this stream to its junction with the Missouri; and also a route from the mouth of Turtle Hill river to Fort Randall. Finally, the road from Fort Randall to Sioux City was surveyed.

With the report on these routes Lieutenant Warren combines that

of the routes examined by him in 1856, under orders from General Harney, of which examinations no report has heretofore been presented.

In that year he made a careful reconnaissance of the Missouri river from the southern boundary of Nebraska to a point sixty miles above the mouth of the Yellowstone, and of this latter stream to Powder river.

The routes explored, including those of 1858, (of which a report has been rendered and printed,) all lie east of the 106th meridian. They lead once through the Sand Hills north and south, and twice east and west, almost around the Black Hills, and through the valleys of the following rivers, viz: the Platte, Loup Fork, Niobrara, White Earth, Big Shyenne, Missouri, Yellowstone, and James rivers.

The accompanying report of Lieutenant Warren is divided as follows:

Part 1 is a statement of the routes pursued and main incidents which affected their direction and extent, and in connexion with this are given the objections urged by the Dakotas against the passage of the expedition through the Territory. This may prove valuable to any white men that may travel there.

Part 2 contains a general description of the surface of Nebraska; an account of the general structure of the country; its principal geological formations and the character of the soil; and its adaptability in different parts to settlement.

It confirms the statements heretofore made by explorers in other portions of the western prairies of the generally sterile character of the lands west of the 99th meridian, attributable to the absence of fertile elements in the soil in large tracts, like the Sand Hill region, and to the want of timely rains.

The section in the mountains bordering these plains on the west is described as containing small fertile valleys, with streams of water and an abundance of building material, both of stone and wood, and an ample supply of the latter for fuel. The opinion is expressed that this section will be overspread by considerable settlements.

Part 3 contains a general description of the rivers and routes through the Territory, with a discussion of the question as to the best route by which to supply Fort Laramie and the interior. The conclusions arrived at in regard to this last question are, that the route up the Loup Fork is impracticable, and, besides, is less direct than the Platte route; that the route along the Niobrara is barely practicable for wagons, and that the difficulties to be met with on the road, together with the increased river transportation of the route, render it less favorable than that up the Platte, whether the starting point be Omaha City or Nebraska City; that a road from Sioux City to Fort Laramie, along the Niobrara, would only be about forty miles shorter than a road proceeding from the same point direct to the Platte, at the mouth of Loup Fork, and thence along the Platte route to Fort Laramie; that the shorter length of the Niobrara route is more than counterbalanced by the great difficulties on that route, and therefore the route along the Platte is the better of the two;

that the route from the mouth of White river west to Fort Laramie is probably practicable, and superior to that along the Niobrara; that the route from Fort Pierre to Fort Laramie is likewise superior to the Niobrara route, but that the increased river transportation and absence of settlements along this part of the Missouri river render these routes at present inferior to those of the Platte valley; that above Fort Pierre, on the navigable part of the Missouri river, there are no routes leading from it to Fort Laramie or the South Pass that are as advantageous as those enumerated. It is further concluded that of all the routes explored the Platte valley is the best adapted for locating a railroad to connect the settlements to be formed in the mountains with those along the Missouri river; and that, as a national route for a Pacific railroad, leading to the South Pass or to Bridger's Pass, it is superior to any other in this latitude. These conclusions appear to be fully sustained by the facts advanced in their support.

The 4th part of the report treats of the Indian tribes, their number, location, &c. An approximate estimate of their strength is made, and routes by which to operate against them, in the event of hostilities, are discussed. Almost every part of the country examined is practicable for the operations of cavalry; and routes practicable for the wagons of a military expedition can generally be found, even in the Black Hills, to such points as would be used as depots from which supplies for brief periods could be furnished for military movements.

The 5th part of Lieutenant Warren's report is a brief statement of the meteorological phenomena of the country, as observed during the explorations; the most prominent facts respecting which are the extreme variableness of the phenomena of moisture and temperature—facts which confirm previous statements in regard to them.

The report contains a catalogue of the fossils collected, with the localities of the specimens, and similar lists of the plants and the collections in the different departments of zoology. All these collections were made without interfering with the more immediate, practical objects of the explorations, and reflect credit on the labors of Lieutenant Warren and his assistants. These collections are esteemed to be of high scientific value; and among the discoveries due to the labors of the expedition are the discovery of the Potsdam sandstone, the oldest of the fossiliferous rocks, in the Black Hills, the first positive proof of the existence in America of the formation corresponding to the Jurassic of Europe, and the discovery on the Niobrara of a new formation of the pliocene tertiary, containing the remains of an extinct fauna resembling that now inhabiting Asia, from which at least thirty-two distinct species of vertebrates have been described by Professor Leidy. The principal of these results have been published, by permission of the department, in the proceedings of the Academy of Natural Sciences of Philadelphia. Accompanying one of these papers, prepared by Dr. Hayden, is a small geological map of Nebraska.

A military map of Nebraska and Dakota, on a scale of $\frac{1}{120000}$, prepared by Lieutenant Warren, and ordered to be engraved by the Senate at its last session, is now ready for publication.

The completion of the exploration of the interior of Nebraska, about the sources of the Yellowstone, Lieutenant Warren thinks could be most advantageously and economically made by an expedition organized to remain at least two years in the field, and the cost of this he estimates at \$60,000. This exploration has been a favorite object with him, and his previous experience, and his knowledge of the Indians and character of the country, would enable him to accomplish the work with economy.

The highly creditable manner in which the explorations heretofore intrusted to him have been conducted, under many embarrassments, difficulties, and dangers, prove him to be peculiarly well qualified for the task.

A detailed plan for the execution of the work will be found in the report.

IV.—THE MILITARY ROAD FROM FORT BENTON TO FORT WALLA-WALLA.

The opening of the military road from Fort Benton, on the Missouri river, to Fort Walla-Walla, on the Columbia river, for which there was an appropriation of \$30,000, was assigned to Lieutenant John Mullan, 2d artillery, on the 12th of last March. On the 25th of May Lieutenant Mullan had organized his working party and left Fort Dalles, on the Columbia river, for Fort Walla-Walla, when intelligence was received by him of the commencement of hostilities by the Indian tribes occupying the regions through which the route he was about to open passes. The party was accordingly disbanded, and Lieutenant Mullan joined Colonel Wright's command, as topographical officer, and in that capacity, and in command of a party of friendly Indians, participated in the campaign upon the Spokane plains. The appropriation was entirely inadequate to the object for which it was designed, and to open a road of similar permanency of character with the military roads in the United States Territories would require a very much larger sum. No estimate of this has been made, but it may be assumed that it will not be less than the amounts expended on equal lengths of route on the wagon roads to the Pacific in other latitudes, for which appropriations have been made.

V.—OFFICE WORK.

In addition to supplying the general map of the United States Territories for military purposes, special maps of the theatres of operations have been furnished to the troops engaged in the field. Maps of each of the military departments are being prepared. Upon the general map of the United States Territories west of the Mississippi, Lieutenant Warren has laid down the approximate boundaries of the various Indian tribes that occupy the country. Copies of this, printed in colors, so as to exhibit the location of each tribe, showing also the limits of the military departments, and positions of the military posts, will, it is believed, be found useful to the War Department and the army, and will materially aid those not familiar with

this region, in comprehending the nature and extent of the military operations necessary to control the Indian tribes.

In preparing this map, besides the information possessed in this office, much that was valuable was obtained from the Indian Bureau and United States Land Office, particularly in regard to the location of the Indian reserves. The attempt to define the boundaries of these Indian tribes is a difficult task, as they are not well established among themselves; and those that are friendly to each other, though using different languages, often mingle to such an extent as to have a common country; as for instance the Crees, Chippewas, and Assiniboinis. It is for this reason, probably, that no map of this kind has ever before been produced.

Upon returning to Washington, in December last, Lieutenant Warren resumed charge of the preparation of the maps, &c., compiling in this office, in addition to the duties connected with his own explorations. He has completed his report upon the general map, which forms a part of the Pacific Railroad Report, and will be published with it.

Lieutenant Abbot, in addition to conducting certain surveys and investigations upon the delta of the Mississippi, under my general direction, and preparing the results, has likewise aided in the duties of this office, and both these officers have, in turn, taken charge of it during my absence.

The appropriation for marking the southern boundary of Kansas directed that copies of the plats of the line should be furnished to the Secretary of the Interior and the Secretary of the Territory of Kansas.

Copies of four of the seven sheets of the map of the boundary, as marked by Lieutenant Colonel Johnston, 1st cavalry, have been prepared for this purpose, and those of the remaining three will probably be finished by the 1st of January. They have been copied by Mr. A. Schimmelfennig, who in this instance has, for the first time in this country, successfully applied the photographic process to copying maps on so large a scale.

VI.—EXPLORATIONS PROPOSED.

The fields of exploration proposed for the next season are, those in Nebraska, before mentioned; the region along the San Juan to its junction with the Rio Colorado of the West, and along the Spanish trail from that river to Abiqui; the route across the Sierra Nevada to Carson's river, to ascertain its railroad practicability; and the upper Columbia river, to ascertain its navigability. These, with the topographical examinations made by officers with the various military commands, will usefully expend the amount appropriated for military surveys and reconnaissances and geographical explorations.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,

Captain Topographical Engineers, in charge.

HON. JOHN B. FLOYD,

Secretary of War.

ARTESIAN WELL EXPERIMENT.

Reports of Captain John Pope, Topographical Engineers, to Captain A. A. Humphreys, Topographical Engineers, in charge of Office of Exploration and Survey, War Department.

WAR DEPARTMENT,
Washington, May 5, 1857.

SIR: In the execution of the duties hereby assigned to you, of continuing the experiment of sinking artesian wells upon the public lands, for which an appropriation of \$100,000 was made, you will be guided by the following instructions:

Proceeding to St. Louis, *via* New York, you will have prepared, as soon as practicable, the tools, machinery, apparatus, and material requisite for the work, employ such mechanics and other persons as may be necessary for the service, and with them repair to San Antonio, Texas, and assume the command of the expedition.

The organization and outfit having been completed, you will move to the Pecos river, near the 32d parallel of latitude, establish your camp at a convenient position, resume the boring of the well left unfinished during the past summer, and continue the work until the water flows out continuously upon the surface. This having been done, and the well left in good condition, you will proceed to the Rio Grande, occupy a position suitable for continuing the experiment begun near that river, and complete the well in like manner with that near the Pecos.

Upon the successful termination of each work, you will report in detail upon it, transmitting at the same time a geological section exhibiting the source whence the supply of water is probably derived.

These two works having been finished and left in serviceable order, you will continue the experiment of sinking artesian wells on the plains or basins east of the Rio Grande, the number of experiments being limited by the amount of the appropriation, which your expenditures for field and office work must not exceed. These wells should be established upon or near lines of military and emigrant roads, if sites can be found at such positions, in every way favorable for the experiments, and two of them should be located upon that portion of the route from Independence to New Mexico, lying east of the Canadian river.

As soon as you have selected the position for a well, you will report the facts that have governed you in the selection, transmitting at the same time detailed descriptions of the locality, with such sketches of the country and geological sections as will exhibit the probable source of the supply of water, the depth to which the boring must be carried, the nature of the formations to be passed through, and all other information necessary to a thorough understanding of the subject, and a demonstration of the practicability, extent, and cost of the work.

These wells will be finished in the same manner as the first two.

Such reconnaissances and geological examinations as may be neces-

sary for the selection of the sites of the wells will be made, as also the usual surveys over the routes pursued by the expedition; and so far as it can be done without interfering with or adding to the expense of the accomplishment of the special object for which the appropriation was made, every opportunity will be availed of to gain information respecting the region over which your movements will extend.

You will obtain from the assistant quartermaster at Fort Fillmore the boring apparatus, matériel, instruments, &c., turned over to him by you at the termination of the work on the Pecos during the last season. Upon the completion of the experiments of sinking artesian wells, you will return by such route as the condition of your party may render necessary or desirable, discharge your employés, dispose of your outfit at some convenient and favorable point, and repair to Washington with such assistants as may be required to complete your report.

The commanding officer of the department of Texas will be directed to detail seventy-five enlisted men of the infantry, with two subalterns, and twenty-five enlisted men of the cavalry, with one subaltern, and order them to report to you for duty, without delay, at San Antonio, Texas.

The officers of the quartermaster's, subsistence, ordnance, and medical departments, serving in Texas and New Mexico, will be instructed to furnish the expedition, upon your requisition, transportation, quartermaster's stores, provisions, arms, ammunition, medicine, medical stores, &c., the articles for the use of the civil employés being paid for out of the appropriation for the well.

So far as it can be done consistently with the proper protection of the work, you will cause working parties to be detailed from the enlisted men of your command to aid in the construction of the wells, who will receive the extra pay allowed by paragraph 883, Army Regulations.

Immediately upon the receipt of these instructions, you will report the kind and amount of boring apparatus, machinery, tubing, tools, and materials, that should be provided for completing the experiments, with their probable cost; the number of assistants and others whom you propose to employ, with their rates of compensation; the train and camp equipage necessary for the operation, with their estimated cost; and the expense of organizing and maintaining the expedition during one year, and also for continuing it a second year.

You will communicate with the department through the Office of Explorations and Surveys, in charge of Captain A. A. Humphreys, Corps of Topographical Engineers; and to this office you will make the reports and returns required by "Regulations of an officer of engineers in charge of a work or operation," and such other reports, transmitted as often as the means of communication will allow, as will keep the department apprised of all your movements and of the progress of the work in your charge.

Before taking the field, you will turn over to the same office the

note books, maps, reports, and results, so far as obtained, of your previous expedition.

Very respectfully, your obedient servant,

JOHN B. FLOYD,
Secretary of War.

Captain JOHN POPE,
Corps Topographical Engineers.

ST. LOUIS, MISSOURI,
May 5, 1857.

SIR: I have the honor to report that I have completed the arrangements and secured the tools and machinery necessary for the duties assigned to me, and only await my final instructions, and the transfer of the funds for which I submitted an estimate.

Everything is in complete and perfect order, and to the manufacture of machinery and the procurement of everything necessary for a thorough discharge of the duty the experience of the past two years has been successfully applied. I doubt not that the expedition will prove as successful as its most sanguine friends could anticipate.

May I respectfully request that Mr. Howard and the other young gentlemen to accompany the expedition be ordered to report to me in New Orleans.

I am, sir, respectfully, your obedient servant,

JOHN POPE,
Captain Topographical Engineers.

Hon. JOHN B. FLOYD,
Secretary of War.

[Extract.]

INDIANOLA, TEXAS,
July 9, 1857.

SIR: I have the honor to report that my party and train marched from this place to-day fully equipped for the plains, and unless some unforeseen delay occurs in providing transportation and supplies at San Antonio for the enlisted men of the expedition, requisitions for which were transmitted some time since to the quartermaster at that place, no halt will be made until I reach my camp on the Pecos.

(Signed by Captain John Pope.)

CAMP ON THE PECOS RIVER, NEAR THE 32D PARALLEL,
September 7, 1857.

SIR: I have the honor to report my arrival at this camp on the 2d instant, and the resumption of the work near this place.

I am now sinking a five-inch hole to the first water (240 feet) into which I shall fit a copper pump for the supply of engine and men. This will occupy us about twelve days, by which time the engine will be fitted up and ready to resume the boring of the well at the depth attained last year, (861 feet.)

I anticipate with confidence, a successful result within two months.

Our march from San Antonio has been rapid and altogether fortunate.

I am, sir respectfully, your obedient servant,

JOHN POPE,

Captain Top'l Eng'rs, com'g.

Capt. A. A. HUMPHREYS,

Top'l Eng'rs, in charge of Office Expl's and Surveys.

An unofficial letter from Captain Pope, dated Camp on Pecos river, October 1, 1857, states: "We are getting along here as well as could be expected, and I hope six weeks will enable us to complete all our operations near this place. The pump has been sunk to the first water, (240 feet,) and is now pumping for the use of the engine. Within the first two weeks we cut and hauled mesquite roots sufficient to run the engine for three months, and everything goes on smoothly and expeditiously. We are now pumping from the well the mud and sand which have accumulated since we left it, and will resume the boring in a few days."

CAMP ON PECOS RIVER, *January 5, 1858.*

SIR: I have the honor to report for the information of the War Department, that we are still engaged upon the "Llano Estacado" in the prosecution of the first experiment of sinking an artesian well.

The time consumed has already been far greater than was anticipated, from the repeated accidents and breakages of machinery, which required much time in each case to repair. The boring has only reached at this date a depth of nine hundred and fifty feet, though I trust that hereafter the work will be more rapidly executed.

Several streams of water have been already intersected since the work was resumed, and the borings now are in the sulphurous shale from which issue the sulphur springs at the head of Delaware creek. I am in daily expectation of striking water which will overflow the surface.

The winter has been unusually severe for this region, and we are in the midst of a norther, accompanied by snow. I have been obliged to send into Fort Davis to be foraged all the animals not absolutely necessary for the work here, and to haul from that place sufficient corn to give the animals here half the ration of forage.

We shall, however, do well enough during the winter, and shall doubtless pass that portion of it which yet remains for us on this plain without suffering any hardship.

I am, respectfully, your obedient servant,

JOHN POPE,

Captain Top. Eng's, commanding expedition.

Captain A. A. HUMPHREYS, *Top. Eng's,*

In charge Office Explorations and Surveys, Washington, D. C.

CAMP ON THE PECOS RIVER, *February 26, 1858.*

SIR: I have the honor to report for the information of the War Department, that the work near this place is still unfinished.

The difficulty in the first instance of sinking tubing to a depth of one thousand feet through strata so slightly coherent as to fall in at almost every point of the entire depth, and which bound the tube so as to render it almost impossible to force it down, consumed much time and labor. The breaking of the boring apparatus near the lower extremity (the middle of an iron sinker thirty feet in length) occasioned further delay, very much prolonged by the caving in of the well above the top of the broken sinker, so as to render a great deal of labor necessary to get hold of it and withdraw it. When all things had been finally set to rights, we had the misfortune, after boring to a depth of 1,047 feet, to burst the cast-iron pump of the engine, and I have been obliged to send as far as Galveston to procure another, as there is no possibility of repairing or procuring such a casting here. The work still goes on, however, as the broken pump can still be made to work, and I have abundant force to push the work by hand if it becomes necessary.

We are boring in hard limestone, very black, and easily recognizable in its outcrop at the head of Delaware creek, about forty feet above the surface of the springs forming the sources of that stream.

I entertain the hope daily of completing the work, which would, no doubt, have been finished long since but for the many and wholly unusual and unanticipated accidents I have referred to.

I am, sir, respectfully, your obedient servant,

JOHN POPE,

Captain Topographical Engineers.

Captain A. A. HUMPHREYS,

Top. Eng's, in charge of office.

CAMP ON PECOS RIVER, *April 1, 1858.*

SIR: I regret to report that the accidents and difficulties we have met with in the prosecution of the work near this place have prevented as yet any advancement of the boring since my last report. The water of the Pecos river, which we are obliged to use in the

boiler of the steam-engine, forms a hard, solid coating around the flues in the course of a very few days, and occasions leakage in the boiler sufficient to prevent the raising of steam. I have been obliged in consequence to refuel the boiler throughout, and to make man-heads enough to enable a man to clean it thoroughly at least once every six days. This has occupied several weeks.

The peculiarity of the formations is another source of great difficulty, which much time and labor are necessary to overcome. For a hundred feet above the bottom of the well there are consecutive strata of soft slate and of hard flinty limestone in thin layers. The slate is washed away by the agitation of the water, leaving the sharp edges of the limestone exposed so as to cut in two in a very few moments the wooden poles, and to bend iron substitutes so that they are rendered useless.

There is great difficulty in sinking the tube arising from the soft, crumbling character of the whole formation from the surface down.

Although the bottom of the tube is perfectly free and loose, the friction along the sides is so great that the driving necessary to move it is sufficient to crush the upper end of it and to tear out the screw threads below.

The tube we are using is the iron (wrought) which you sent from Philadelphia last year.

We are now endeavoring to sink the tube to the bottom with fair prospect of success, though it will be a work requiring time.

I have little doubt we are in close vicinity to the water, as the formations are peculiar and readily identified with their out-crop, about forty feet above the head springs, Delaware creek.

I have reduced my party to the smallest possible limits, and shall be able to maintain it in the field at least to July 1, 1859.

I send herewith topographical and geological sketches and sections exhibiting in detail all possible information concerning the vicinity of the well. The geological section from the Guadalupe mountains, exhibits as you will observe some different features from those heretofore sent. I have satisfied myself for sufficient reasons that the Pecos flows through a valley occasioned by upheavals along lines both east and west, and is not a valley of denudation. The dip of the strata from the Guadalupe mountains is not continuous across the "Llano Estacado" with a constant descent, but rises east of the Pecos in a gentle undulation without fracture to the summit of the plain, at an altitude of six hundred feet above the river, and a distance of about thirty-five miles from it.

The geological section will exhibit plainly what I have stated.

I will of course prosecute this work with all vigor and perseverance, and I by no means despair of completing the work here in time to accomplish a large portion of what was proposed when the expedition took the field.

Extract from a letter from Captain A. A. Humphreys, Topographical Engineers, in charge of Office of Explorations and Surveys, dated April 14, 1858.

"SIR: Your reports from the camp on the Pecos river of the 26th and 28th of February were duly received, and submitted to the Secretary of War.

"In consideration of the unexpected difficulties and consequent, unavoidable delays that have occurred in your work upon the artesian well near the Pecos, the Secretary of War directs that, upon the completion of that well, instead of proceeding to complete the artesian well west of the Rio Grande, you will omit that work and continue the experiment of sinking artesian wells on the plains or basins east of the Rio Grande, as indicated in the fifth paragraph of your instructions of the 5th of May last."

CAMP ON PECOS RIVER, May 1, 1858.

SIR: I submit the following report of operations in the prosecution of the experiment of sinking an artesian well on the "Llano Estacado."

The boring is done by means of oak poles, $1\frac{3}{4}$ inches in diameter, in 16 feet sections joined in twos by heavy iron straps. Each boring rod is therefore 32 feet long with a male screw at one end and a female screw at the other, both having very strong and heavy threads. The drill has a straight edge of $3\frac{1}{2}$ inches, and is attached to an iron rod 30 feet long and $1\frac{1}{4}$ inch in diameter. To the upper end of this rod (or sinker) is attached a pair of iron slips, having a play of 16 inches (the fall of the drill) and to these are screwed on the wooden poles, up to the surface. The upper end of the poles is attached by a moveable chain to a spring beam worked by steam, and (boring at the usual speed) the drill falls fifty-five times in a minute. The borings are pumped out by a sand pump of copper, 9 feet long, which works with a rope passing round a drum attached to the steam engine. The hole is pumped out on an average once in $2\frac{1}{2}$ hours of boring.

The difficulties we have encountered have resulted from the peculiar soft and crumbling strata of variegated marls and clays, which are of an uncommon thickness, not, I believe, to be found elsewhere within the range of geological examination. It has been necessary in this case to line the well with tubing from the surface, and as combining strength and lightness wrought iron tubing $\frac{3}{16}$ of an inch thick was brought out with the expedition.

The first difficulty met with was in sinking the tubing to a depth of 81 feet lower than it was left last year (810 ft.). Although with the under cutting drills it was easy to enlarge the bore below the tube so as to admit the latter to pass down freely, yet the friction along the sides resulting from the crumbling and falling in of loose slightly coherent strata around it, was so great that it required driving as heavily as it would bear to force it down. Next the iron sinker broke off in the middle and before anything could be put down to withdraw it the

well caved in for sixty feet above it and completely covered it. Six weeks were passed in clearing the well and getting out the broken sinker. Next the water used in the engine, in consequence of large quantities of lime and sand held in suspension soon coated the flues of the boiler with a very hard scale and caused them to leak badly. It was therefore necessary to take down the engine and reflow it entirely, inserting manheads for cleaning. Very shortly after we again resumed boring we passed into alternating thin strata of blue slate and flint limestone, the most difficult strata we have yet encountered. Water pours in at several places in the well in considerable streams, and very soon washes away the slate, which is soft, but leaves the sharp jagged edges of the hard limestone fully exposed; in a very little while the wooden rods working through these strata would be cut in two; iron rods were substituted, but they were soon bent so badly, by coming into violent contact with the sharp limestone, as to be useless; I therefore was obliged either to diminish the bore by inserting smaller tubing, or sink the large tubing to the bottom. The exceeding difficulty of the last plan induced me to prefer the former, and the hole was lined with three-inch copper tubing from the lower to the upper thin layer of limestone. Unfortunately, very soon after effecting this, the iron slips broke immediately beneath the bottom of the copper tube, and so spread apart that they could not be withdrawn through the tube; it was therefore necessary first to take out the tube—a work of difficulty. It was all gotten out except nine feet of the lower part, which pulled off, and had to be bored and speared up. The boring up and pumping out of the copper tube was completed yesterday, and the head of the broken slips is now exposed so that they can be withdrawn.

Since our arrival at this camp we have been thus embarrassed by difficulties and breakages, altogether due to a most peculiar, difficult, and uncommon formation of great and hitherto unknown thickness. The strata are so distinctively marked that they can be easily recognised in their outcrop between the Pecos river and the Guadalupe mountains; and we have reached the stratum of slate exposed plainly at the head of Delaware creek, about forty feet above the issue of the powerful fresh and mineral springs which form the sources of that stream.

The winter here has also greatly incommoded us from inadequate protection of the men from unusually inclement weather for this region, and there were many days during the severe northers, incident to this country, in which it was impossible to work. The spring is now fairly open, and I trust we shall soon be able to finish this work, as I am altogether certain that the water is but a little way below us.

I am, sir, respectfully, your obedient servant,

JOHN POPE,

Captain Top'l Engineers.

Capt. A. A. HUMPHREYS, *Corps Top'l Engineers,*

Washington, D. C., in charge of Office Expl's and Surveys.

CAMP ON PECOS RIVER,
June 4, 1858.

SIR: I have the honor to report that abundant springs of living water have been discovered on the summit of the Llano Estacado, fifty miles due east from this camp, and about half way between the Pecos and the Mustang springs. An exploring party which I sent out some days since returned to-day, after having carefully explored the country eastward from this place, and have found a hard firm road over the entire distance to these springs. From this camp in a due easterly course to the Mustang springs, is a distance of ninety-five miles, with a hard gravelly road over the entire distance, and all trouble about crossing this plain is not only entirely obviated by this discovery, but a saving of distance amounting to at least eighty-five miles has been effected.

Two hundred of these springs, some of them thirty yards in circumference, have been found extending in a direction north and south over a space of nine miles. Everywhere in the neighborhood of the water we found groves of willow trees thirty feet high, and from four to six inches in diameter. They will furnish abundantly the material necessary for constructing the stations which may be required.

The existence and character of these springs are exceedingly peculiar and difficult to be accounted for.

Commencing about three miles north of the 32d parallel of latitude, and fifty miles east of the Pecos at this camp, is a range of abrupt white sand hills, seventy or eighty feet higher than the surface of the plain, which extends in a direction a little east of south for about fifty miles. To the east, west, and north, the country descends rapidly from the summit or back-bone of these sand hills, which is the highest line for ten or fifteen miles in any direction. Along the very summit of this ridge issue the springs I have mentioned, bubbling up through beds of loose white sand of indefinite, or rather undetermined depth. They are not at all affected by surface rains, as there is not the slightest evidence on the banks of their ever rising or falling, and the surface drainage is from them in all directions.

As I have stated the line of these springs or pools has been traced for nine miles towards the south, exhibiting in this distance two hundred considerable pools of water. In most cases the pools are from three to four feet in depth, but in some of the larger ones the depth is six feet. The water is perfectly transparent, and free from impurities. There seems to have been originally a considerable stream of running water, resembling Delaware creek in character, that is, a succession of deep pools connected by a swift running stream some two feet wide, and with perpendicular banks about three feet high. The sand seems to have drifted before the violent winds along the course of the stream until it has entirely covered the small narrow streams connecting the ponds. This could readily have been done, as the flags, bullrushes, and cane grow so thick and matted along these narrow threads of water as completely to overlap each other from both sides, so that even along Delaware creek the narrow

stream connecting the large pools is altogether hid from the summit of the bank.

This seems the only way to account for the peculiar character of these springs, and I am still further confirmed in this opinion from the fact that holes were dry in several places between the springs, into which water rose from a depth of several feet, and overflowing the surface immediately ran off in a small stream into the spring to the south.

The existence of this water and of a hard firm road across the plain, will be of prodigious service to travel, and is particularly fortunate in being discovered at this time, as it is precisely on the most direct route of the semi-weekly mail to California. Its discovery also will greatly diminish the importance of the artesian well boring experiment in this plain.

I transmit herewith a topographical sketch exhibiting the situation of these springs with respect to known points both east and west. You will perceive that the lines of survey heretofore made across the Llano Estacado pass only a few miles to the north and south of this line of springs, and certainly there is no evidence of the existence of water in the midst of these bare sand hills until you are directly in the midst of them.

I am, sir, respectfully, your obedient servant,

JOHN POPE,

Captain Topographical Engineers.

Captain A. A. HUMPHREYS,

Corps Topographical Engineers,

In charge Office Explorations and Surveys, Washington, D. C.

The water of these springs is undoubtedly not surface water, and must come from a depth greater than any of the streams intersected by the boring, as the surface of the springs is at least three hundred feet above the surface of the ground at the artesian well camp.

The geological formation in the immediate vicinity of both places is the same, the gypsum and the loose pulverulent limestone appearing on the surface.

J. POPE,

Captain Topographical Engineers.

CAMP ON PECOS RIVER, *June 4, 1858.*

SIR: I have the honor to report that after incredible difficulty and labor we have at last succeeded in withdrawing from the well the broken sinker and bit, and are now commencing again the boring operations.

The peculiarity of the geological structure of this plain for so many feet below the surface, in conjunction with the action of powerful streams of water which pour into the well without rising to the surface, occasion difficulties in the work which no previous experience in artesian well boring has yet exhibited. In less than one week

after the boring has passed below the tubing, the rush of water so causes the sides of the well to cave and fall in as to leave large caverns in some places, and in others sharp jagged edges of hard sandstone and limestone, which almost destroy the boring rods, whether wood or iron. At a distance of forty feet below the bottom of the $3\frac{1}{2}$ inch tube there is a strong stream of water pouring in, which has made a cave so large that broken iron rods five feet long completely disappear in it, though entering it perpendicular to the bore. It is so exceedingly dangerous, in consequence of the numerous breakages and accidents incident to such work, to insert smaller tubing, that I am very reluctant to do so if I can possibly avoid it.

In a tube so small as $2\frac{3}{4}$ inches in diameter it is next to impossible to put down any socket or hook to get hold of broken poles, slips, &c., and the last long delay we have just terminated was due to this very difficulty. When once a tube is put down through such a crumbling formation as characterizes this plain, it is next to impossible to withdraw it again, as the falling in against it of the soft strata for its whole length binds it fast in the hole.

In the present case we were obliged to bore up a part of the small tube, and pump it out before we could get hold of the broken slips and sinker. The large tube hangs free at the bottom, and nothing prevents its going down except the friction along the sides, resulting from continuous falling in of earth from top to bottom; but so great is this friction that, in order to move the tube down, it is necessary to drive it with such violence as to strip off the screw-threads and split the tube. I have been putting down the large tube, however, for several days past, with much success, by inserting a mandrill and driving, so that the strain is near the bottom.

Even should the screw-threads strip off in this process, one piece, at least, will go down, and they can be thus driven down in succession, and the contact made sufficiently perfect to answer our purposes. I have no expectation that much more depth of boring will be necessary, but our difficulty has been in boring *at all*. We are now fairly under way again, and I hope will meet with no further trouble. Much, if not all, our trouble since we last commenced this work could have been obviated by bringing out heavy cast iron tubes and the necessary driving apparatus; but the weight of the tubes and apparatus would have been so exceedingly great as to have rendered it a work of large expense to haul them five hundred miles across the plains. The tubing we have (wrought iron and copper) is admirably adapted to work of this kind at any place not so peculiar as this, and I anticipate no serious delay or difficulty after I once leave this place.

In this connexion I beg to present some suggestions for the consideration of the department:

1. The boring operations are fairly progressing again, after long delay and severe labor, and if no further difficulties occur, the work bids fair to be completed any day. On the other hand, it is possible we may be again arrested by the recurrence of continued difficulties, so as to be little advanced at the expiration of several months.

2. It will be difficult, if not impossible, to keep laborers and me-

chanics another winter, exposed as they must be to the severity of the weather on this exposed plain. The severe cold is also peculiarly destructive to animals, for which we can make no shelter whatever, as there is no timber nearer than seventy miles, and we cannot spare either men or wagons to send for it. It has been as much as we have been able to do to discharge the absolutely necessary duties of this work, and keep ourselves supplied with rations and the animals with half forage, both of which must be hauled one hundred and twenty miles.

3. If there be any well-founded hope that we can finish this work within any reasonable period, we can surely do it in four months, during which time, without the unusual accidents which have heretofore delayed us, we can carry the boring to a depth of 2,200 feet. I would suggest, therefore, to the honorable Secretary of War whether it would be judicious to expend the whole of this appropriation upon the Llano Estacado, where this experiment may prove unsuccessful from the difficulties of the work; or whether, at the end of three or four months longer, it would not be advisable to test the question at some of the other points had in view when this expedition took the field, and which are not inferior in importance. One point in especial, where it has been long my design with the approval of the department to make one of the experiments, is on the 35th parallel route, between Anton Chico and Albuquerque, where there is now a distance of nearly eighty miles without water. The great military road from Independence and Fort Leavenworth to New Mexico passes over this plain, and all supplies and munitions for the department of New Mexico are hauled over it to the depot at Albuquerque.

The great valley thus destitute of water is immediately south of Santa Fé, and extends without interruption the whole length of territory south of that place. The soil is excellent; there are abundant forests of cedar in the valley and pine in the mountains, and on the west side of the valley are the gold placers of New Mexico. It is a point of much importance both to the government and to the people of New Mexico, and it would indeed be unfortunate should this expedition be so long delayed here as to render it impracticable, with the appropriation, to make the experiment at that place.

I make these suggestions to the department thus early, first, because I cannot expect a reply in less than three months, by which time, without renewed difficulties, this work will be finished; and second, because my instructions require me to remain here "until water overflows the surface."

The experiment at Doña Ana is the most doubtful of success, as the department has been informed hitherto.

I have to request that communications for me be addressed to Fort Davis, *via* San Antonio.

I am, sir, respectfully, your obedient servant,

JOHN POPE,

Captain Topographical Engineers.

Captain A. A. HUMPHREYS, *Topographical Engineers,*

In charge of Office of Explorations and Surveys.

WAR DEPARTMENT, OFFICE EXPLORATIONS AND SURVEYS,
Washington, D. C., July 10, 1858.

SIR: Your report of the 4th of June has been received and submitted to the Secretary of War, who approves your suggestion that the work upon the well near the Pecos be discontinued about the end of September, if it should not be completed in the manner required by your instructions at that time. In the event of its abandonment before such completion, your operations must be considered as establishing the impracticability of sinking artesian wells upon the Llano Estacado and other plains in that region of similar formation and position.

On the 14th of April last you were directed to omit the work upon the well west of the Rio Grande, and upon the completion of the well near the Pecos, to continue the experiment on the plains or basins east of the Rio Grande, as indicated in the 5th paragraph of your instructions of the 5th of May, 1857.

Your suggestion that the next experiment after leaving the Pecos be made upon or near the route between Anton Chico and Albuquerque is also approved, and you will begin the operations for boring as soon as you have found what appears in your judgment a suitable point for obtaining water, and where supplies of it are needed on or near that route.

Your letter of the 4th of June states that the distance over which water is not to be had between Anton Chico and Albuquerque is about 80 miles. Lieutenant Whipple, in his report on the route for a Pacific railroad near the 35th parallel, represents the route from Anton Chico to Albuquerque to be well supplied with water except for two months in the year, during which time there is no water on a portion of the route though that portion is much less than that mentioned by you.

Having ascertained a suitable point for boring a well on this route, and commenced operations, you will report to this office the exact distance at which permanent supplies of water already exist, and also the practicability of supplying the intervening spaces with water by means of tanks, ponds or dams, in the event of the boring proving unsuccessful.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,

Captain Topographical Engineers, in charge.

Captain JOHN POPE,

Topographical Engineers, Fort Davis, Texas, via San Antonio.

CAMP ON THE PECOS RIVER,

June 30, 1858.

SIR: I have the honor to report for the information of the War Department, that the boring operations at this place have not been carried to any greater depth than was attained at the date of my last report.

Two weeks from June 1 were spent in efforts nearly ineffectual to force down the $3\frac{1}{2}$ inch iron tubing. For this purpose, the spring (or undercutting) drills were employed and the bore of the well enlarged to $4\frac{1}{4}$ inches in diameter for seventy-eight feet below the bottom of the tube. As I have before stated the friction on the sides of the tube is so great that severe driving is necessary in order to move it, and after driving down about twelve feet, three screw threads were stripped off, and the lower portions of the tube below the fractures so much crushed as to render impracticable any further efforts to sink it. It cannot, of course, be withdrawn for the same reasons. As the well was kept constantly filled up to very near the bottom of the iron tubing, it was then necessary to insert again the copper tube of smaller diameter. This has been done, and we are now engaged in pumping out from the inside of the latter in order that it may sink down as far as practicable. Independently of the danger and inconvenience of working inside of a tube so small, I have little expectation that more than a temporary advantage will be gained by the insertion of the copper tube.

The strata continue to crumble and fall in below where it can possibly be driven. I am constrained to say after ten months of very severe and unremitted labor that, I fear that, without greater facilities and more extensive preparations than could have been secured under the appropriation for this service, or could have been transported without enormous cost, it will be impracticable to overcome the mechanical and physical difficulties of this work.

I have the most experienced and capable superintendent of boring to be found in the west and a full complement of mechanics and borers, who have been for their whole lives employed in such business, and who, under charge of the superintendent now with me, last bored the deep and difficult well of Belcher & Co., in St. Louis.

They are all eminently competent, but the difficulties of the work here are foreign to the experience of any artesian well borer in the United States. In my own opinion there are but two ways by which to accomplish this work, and both involve expenditure beyond the reach of this appropriation; the first by bringing out very heavy cast iron tubes and the necessary driving apparatus, and the second by bringing tubing of all sizes from three inches to twelve inches in diameter.

In either case the cost would be beyond the reach of any appropriation likely to be made.

The certainty of getting water in this plain to overflow the surface, is as well settled in my judgment as it ever was, but the mechanical and physical difficulties of executing the work, arising from a most peculiar, extensive, and uncommon succession of crumbling strata which at a depth of one thousand and forty-seven feet still remain of unknown thickness, are beyond measure greater than could have been anticipated.

The point reached by the boring, and the debris pumped out, are easily identified with the strata outcropping about forty feet above the head spring of Delaware creek and in their immediate vicinity,

but what thickness the same strata have attained at the point of boring it is impossible to say.

I have the honor again to invite the attention of the department to the suggestions for the further prosecution of this work contained in my letter of June 4, 1858.

I am, sir, respectfully, your obedient servant,

JOHN POPE,

Captain Topographical Engineers.

Captain A. A. HUMPHREYS,

Corps of Top'l Eng'rs in charge

Office Expl's and Surveys, Washington, D. C.

CAMP ON PECOS RIVER,

July 27, 1858.

SIR: I regret to be obliged to report that the operations at this place have not advanced in the least since the date of my last report, and that in my judgment and in conformity also with the opinion of Mr. Brown, the superintendent and principal mechanic of the artesian well boring, it will be impracticable without largely increased facilities and consequent expenditures to prosecute the work further. The difficulties resulting from extreme singularity and extent of geological structure, together with the extremely injurious action of the Pecos river water upon iron machinery I have already explained to the department.

The boiler of the steam engine has been completely devoured by the acids of the water so that iron nuts half an inch thick crumble in the hands like clay. The plungers of the supply pump and steam chest are completely honeycombed, and every part of the engine accessible to the water has been more or less injured by it. It has been necessary to procure a new boiler in view of any future work, and I have, therefore, sent three wagons to Indianola to bring one up. I endeavored after the complete destruction of the boiler to carry on the work by hand, but after a depth of nine hundred feet, boring by hand even under favorable circumstances is nearly impracticable, in the present case it is wholly so.

The utmost that I am able to do to complete this work has been done, and but for the specific orders of the Secretary of War, I should move at once from this place to a point east of the Rio Grande and west of the Pecos, where the structure is more favorable, and where the work could be carried on with some prospect of success.

I hardly consider it possible under any circumstances to keep this party another winter in this plain. The past winter was severe, and the men suffered much. It was entirely unexpected by every one familiar with this bleak and exposed plain, that this command would attempt to winter upon it exposed as they must be with very insufficient shelter, and I have no idea that any of the civil employés who are absolutely necessary for the work could be induced to remain thus exposed another winter. The military, of course, could be coerced

into another campaign equally severe, but they would be useless alone.

I lay all these facts, and my own opinions upon them, before the department with great regret. I have long been interested both personally and officially in this experiment, and have spent three years in laborious efforts to accomplish it. The disappointment I feel in being again obliged to relinquish it uncompleted is very great, but I am assured that the department will do justice to the zeal and industry with which it has been prosecuted.

I have the strong belief that the success of the experiment in other places will yet justify the expenditures the government has made, to determine a question of so much consequence.

I shall await the decision of the War Department as to my future operations at this camp. I regret to report also that scurvy is beginning to break out in the command, and that no supplies of anti-scorbutics can be procured except the fresh vegetables on the Rio Grande one hundred and seventy miles distant, and which completely spoil before they can be hauled out to this camp. The command has now been nearly a year without supplies except the bare ration.

I am, sir, respectfully, your obedient servant,

JOHN POPE,

Captain Topographical Engineers.

Captain A. A. HUMPHREYS,

Corps of Top'l Eng'rs in charge

Office Expl's and Surveys, Washington, D. C.

CAMP ON PECOS RIVER, ,

August 22, 1858.

SIR: I have the honor to report that since the date of my last report, the work of boring has been completely arrested, as with men it is impossible to handle an auger of 1050 feet. I am waiting the return of the wagons sent to Indianola, Texas, for a new boiler, but I have to say that I do not consider it practicable to carry these borings to greater depth with any means within reach of the appropriation. It will in my judgment be a waste of time and money further to prosecute the work under present circumstances. I therefore recommend that the party be moved to some other of the points designated in my instructions, where the chance of success will be far better.

The geological structure of this plain is so very peculiar, its extent so much greater than is known to the experience of any geologist, and in consequence the mechanical and physical difficulties of carrying borings to a greater depth, have been so constant and so unusual in the history of such operations, that after a whole year of unremitted and laborious work, the boring has been scarcely at all advanced.

Facilities and conveniences impossible to secure at a point so remote will be essential to a successful completion of any such experiment on the Llano Estacado, and until the government is willing to go to ex-

pense beyond reasonable hope, I fear this great plain must be left to its pristine solitude and desolation.

As the department is doubtless familiar with such operations, I will explain briefly the peculiar obstacles we have encountered, the more remarkable from the great depth to which they have pursued us.

The upper geological formations of this plain consist of what are known to geologists as *cretaceous strata*, which here are nothing more than alternations of strata of soft sandstones and variegated marls and clays. In every other part of the world, where these strata have been developed, they are comparatively of small extent, particularly in depth, and with a short departure from the surface of the ground, the sandstones become much harder, and the variegated marls and clays become gradually converted into shales and slates. Almost the precise reverse seems to be the case here, and at a depth of one thousand and fifty feet the strata are softer and crumble more easily than at the surface. We have encountered occasional thin seams of flinty limestone, but of too little extent to modify the very peculiar physical character of this formation.

The first effect of such a geological structure is the necessity of tubing any well to be bored from the very surface, and forcing or trying to force the tube to follow the auger closely. This I found is easy enough to do, as I had come prepared for such obstacles, and had plenty of wrought iron tubing and spring or undercutting drills. With the latter we were able, without the least difficulty, to enlarge the bore, below the tube, to any size necessary; but we had not progressed more than six hundred feet with the work, until the friction along the sides of the tube, from top to bottom, resulting from the falling in around of the loose, crumbling strata, absolutely prevented it from moving down, although the bore below was a full inch and a half greater in diameter than the outside of the tubing. I then commenced to drive, and succeeded, by using great care, in getting it down two hundred feet further. Beyond that depth, the friction became so great, that the force necessary to overcome it crushed the wrought iron tube, and stripped off the screw threads at the joints.

It was impossible to carry the boring below the tube, as the crumbling strata of marls and soft sandstones commenced at once to fall in, when unsupported, and filled up the well faster than it could be pumped out. I had, however, anticipated this difficulty, and had brought out tubing of different diameters; and as soon as I found that the large tube could be drawn no further, a smaller one was pressed down inside, and the diameter of the well reduced.

For a while this obviated the difficulty, but after one hundred and fifty feet the small tube could no longer be forced down, and the strata still continued soft, and fell in constantly.

By these means, and with the severest labor I ever saw, both night and day, exposed on this bleak plain with little protection to an inclement winter, we succeeded in reaching a depth of one thousand and fifty feet; no change whatever has occurred in the strata; they are as soft and crumbling at the bottom of the well as at the top, and it is impossible to say how much longer they will continue so.

These constitute our physical difficulties, and they are, so far as I know, foreign to the experience of any well borer in the United States. Certainly no difficulties of the kind are recorded in the history of such operations elsewhere. The mechanical difficulties of the work have also been peculiar and almost irreparable.

The water used in the boiler of the steam engine was hauled in wagons from the Pecos river, a distance of eight miles. It carries an enormous quantity of angular sand and finely comminuted gypsum in suspension, and causes by these means the utmost trouble in getting the boiler free from the solid and rapid incrustation accumulated on the flues.

The gypsum and sand combined form a crust as hard as flint, and so firmly attached to the iron that it was necessary to take down the boiler and chip it off with chisels. If left more than six days it became at least half an inch thick. The sand also completely cut to pieces and honeycombed the valves and plungers of the supply pump until it became altogether useless, and I was obliged to send to Galveston for another.

The water of the Pecos also contains a large quantity of free acids, which absolutely devoured the iron, until the boiler a few days ago became completely useless, and I have again been compelled to send to Galveston. At least two-thirds of the thickness of the boiler iron was eaten up by the acids, and iron nuts half an inch thick crumbled in the hands like dried clay. The plunger of the steam chest is also completely honeycombed; and wherever iron has been exposed to the action of this water, especially in a boiling state, it has been greatly injured.

Such in brief are the difficulties, mechanical and physical, which have so long embarrassed the work, and which I fear it will be impossible to surmount at a place so remote from every convenience, and where it is so nearly impracticable to replace any part of the necessary machinery.

With very heavy cast iron tubes and driving apparatus it might be practicable to complete these borings; but the transportation alone of such heavy articles, in quantities sufficient for the object, would involve an expense beyond the reach of any appropriation Congress will ever make for such a purpose.

This, however, is but one of many points had in view for these experiments when I left Washington, and I do not doubt I shall have much better success elsewhere, as this plain stands alone in its peculiar character.

In the boring, so far as we have carried it, abundant springs of water have been passed through, (four or five in number,) but they do not rise to the surface, and their existence is rather a disadvantage to the work, as they greatly increase the rapidity of the falling in of soft strata.

My opinions about the certainty of getting water to overflow the surface are by no means changed; but the boring operations are difficult far beyond my anticipations, and lead to the conclusion that,

under the present condition of this country, the expense of successfully completing the well would not be justified by its necessity.

The man in charge of the work bored the deep well of Belcher & Brother in St. Louis, and has with him the same mechanics and borers employed on that work. He is eminently competent, and indefatigable; and his conduct here has fully justified the high recommendation with which he joined me.

It is of course a disappointment to me, under the circumstances, again to leave this work unfinished, but the best that was possible has been done, and there is nothing more to be said.

I am, sir, respectfully, your obedient servant,

JOHN POPE,

Captain Topographical Engineers.

Capt. A. A. HUMPHREYS,

Corps Top'l Eng's, Washington, D. C.

CAMP NEAR FORT FILLMORE, N. M.,

September 6, 1858.

SIR: I have the honor to report that, in accordance with the approval of the War Department contained in your letter of July 10, I broke up my camp on the Pecos, and am now en route for the route between Albuquerque and Anton Chico.

My communication of August 22 will inform you fully of the condition of the work near the Pecos, and the grounds upon which I broke up my camp immediately upon receipt of your letter of July 10. Nothing had been done for several weeks previous, for the reasons stated, and both time and means were being lost by further delay at that place.

I shall march for Galisteo to-morrow, and shall probably reach there by the 21st instant. A full report and sketches will be transmitted to the department immediately upon my arrival at that place.

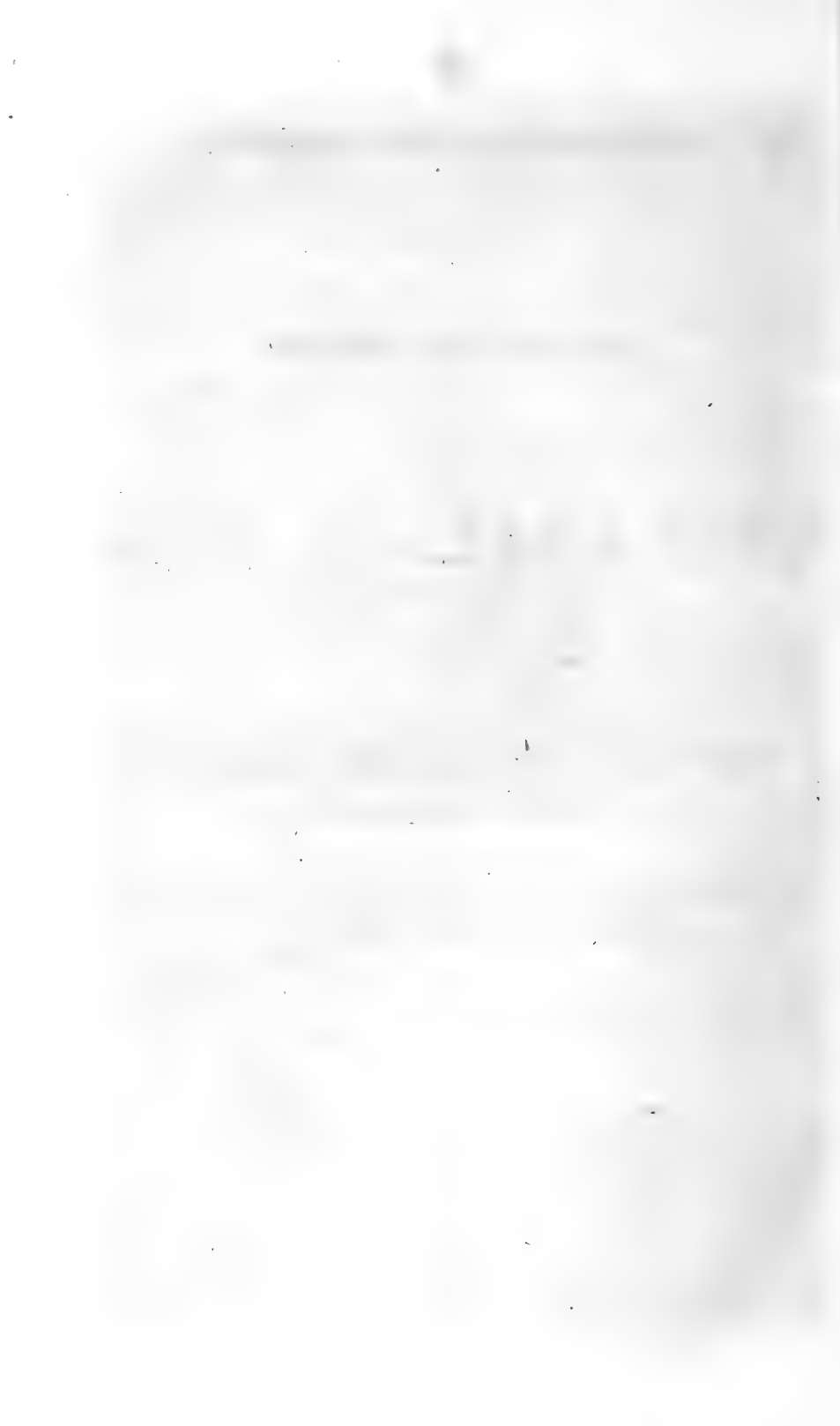
I am, sir, respectfully, your obedient servant,

JOHN POPE,

Captain Topographical Engineers.

Captain A. A. HUMPHREYS,

Corps Topographical Engineers, Washington, D. C.



COLORADO EXPLORING EXPEDITION.

PRELIMINARY REPORT

OF

FIRST LIEUT. J. C. IVES,

TOPOGRAPHICAL ENGINEERS,

TO

CAPTAIN A. A. HUMPHREYS,

TOPOGRAPHICAL ENGINEERS,

IN CHARGE OF THE OFFICE OF EXPLORATIONS AND SURVEYS,
WAR DEPARTMENT, NOVEMBER 1858.

WASHINGTON, *November 1, 1858.*

CAPTAIN: I have the honor to submit, for the information of the department, the following brief synopsis of a portion of the results of the expedition organized under my command for the exploration of the Rio Colorado of the west.

I sailed from San Francisco for the mouth of the Colorado river on the 1st of November, 1857, in the quartermaster's schooner used in transporting stores to the head of the Gulf of California. On board were the property and supplies belonging to the expedition, and also the materials for constructing a small iron steamer, to be employed in

ascending the river. I was accompanied by a steamboat engineer and a party of seven men. The other assistants and employés took the steamer for San Diego, and crossed by land to Fort Yuma, which is on the Colorado, 160 miles above its mouth.

EXTENT OF EXPLORATIONS.

The schooner arrived at the mouth of the river on the 2d of December, having been much delayed by calms and head winds. The steamboat was finished and launched on the 30th of the same month, and the ascent of the river was commenced on the day following. I continued up the river for 500 miles, reaching, on the 11th of March, in latitude $36^{\circ} 06'$, the mouth of a stream supposed to be the Rio Virgen, beyond which it was impracticable to proceed in boats. I therefore sent back the steamboat and the hydrographic party to Fort Yuma, and, taking advantage of the permission granted in the instructions from the department, left the river on the 23d of March, with a pack train, to examine as far as possible the country through which the upper Colorado and its tributaries flow.

Keeping as near as possible to the river, I traversed the region along the 36th parallel, the greater portion of which had been previously unexplored. Most of the line of the 35th parallel was also visited. Following various lines of examination gradually conducting towards the east, I arrived, about the 1st of June, at Albuquerque, on the Rio Grande, the distance accomplished during the land explorations amounting to nearly 900 miles. At Albuquerque the expedition was broken up, a few members of the party still retained returning home by the overland route to Fort Leavenworth.

NAVIGABILITY OF THE COLORADO.

During the progress of my work upon the navigable portion of the Colorado the water happened to be, according to the evidence of those who had lived in that vicinity for many years, unprecedentedly low. An opportunity was therefore afforded of trying the experiment of steam navigation at the worst stage of the river, and at a time when the difficulties ordinarily to be encountered would be considerably magnified.

The region at the mouth of the Colorado is a flat expanse of mud. The lines of the shore and the channels that afford entrance to vessels from the Gulf are shifting and changeable, and bars, shoals, and islands, composed of a semi-fluid mass, are in constant progress of formation and removal. The navigation for thirty miles above is rendered periodically dangerous by the strength and magnitude of the spring tides. These have a rise and fall of from twenty-five to thirty feet, and a flow of extraordinary velocity. The flood is preceded by a "bore," or huge tide wave, from four to seven feet high.

In certain narrow bends it is very powerful and violent, but gradually loses its force as it ascends, and at a distance of thirty miles is scarcely perceptible. Along wider portions of the river there are curves of the shore in which its force is not felt, and here boats may be safely moored till this dangerous wave has rolled by. Upon the shoals are formed what are called "tide rips," where the sudden check given to the rushing volume of water causes it to bound along in high successive waves. Steamboats that come to the mouth of the river during the spring tides must descend from above tide water during the ebb, and start to return two or three hours after the commencement of the flood.

The neap tides have a rise and fall of only ten feet, and a moderate velocity.

Between tide water and Fort Yuma the principal obstructions to navigation are the sand bars. These become more frequent and difficult as the river is ascended. The channel is exceedingly circuitous and constantly changing. The average depth is about eight feet. Shoals were frequently encountered, however, where there were scarcely two feet of water. Experience alone can afford the capability of navigating this portion of the river successfully. A knowledge of the locality of the channel cannot be imparted, as it has been known to shift from one bank to the opposite one in a single night. From the formation of the banks, from the appearance of the water, of the eddies, of pieces of drift wood and other floating substances, and of the islands and bars visible above the surface, a practiced eye can do much towards selecting the proper course, though boats rarely make a trip between tide water and Fort Yuma, at the low stage of the river, without grounding many times a day. The bars, however, are composed of soft and loose material, and may always be passed with more or less labor, depending in a great measure upon the skill shown in the employment of the different methods of extrication resorted to.

Below Fort Yuma there are no rocks. The snags are numerous, but seldom dangerous.

During the months of April, May, and June, while the river is rising, and before new bars have had time to form, the navigation is most easy. The average velocity of the current at low water is two and a half miles an hour, during the July freshet from five to six. The river at this season is about ten feet higher than during the winter months.

For three or four years an enterprising company has been engaged in transporting government stores in steamboats from the mouth of the Colorado to Fort Yuma, and their persevering energy has so far succeeded in overcoming the natural difficulties of the navigation as to enable them now to perform the trips with entire regularity and certainty.

For one hundred and eighty miles above Fort Yuma the navigation has a character similar to that already described. The river passes through several chains of hills and mountains, forming gorges of cañons, sometimes of a considerable size, and in these there is generally a better channel than in the valleys.

During the next hundred miles gravelly bars are of frequent occurrence, and at some of them the stream presents almost the appearance of a rapid. In the intervals between, in both valleys and cañons, are stretches of good river, and although the bad places are worse, the channel generally is better than it is below.

For the succeeding fifty miles the river bed is composed in a great measure of coarse gravel and stones, and many swift rapids were encountered. Upon several were found not over two feet of water. In this portion of the river there are a few sunken rocks, that would be dangerous till their position became known.

The "Black Cañon," which is twenty-five miles in extent, is now reached, and in it the rapids are numerous and difficult.

Above the cañon the river is wide and shallow, and assumes the character of a rapid for so long a distance as to render any attempts to carry boats to a higher point almost valueless, and, considering the difficulty, hazard, and expense that would be incurred at the low stage of water in taking steamboats through the cañon, I am of the opinion that its mouth should be considered the practical head of navigation. Up to this point the Colorado, notwithstanding the difficulties to be encountered, may be pronounced navigable. The experiment was attempted, as has been stated, at a time when the river had experienced an unprecedented fall. At most seasons of the year the navigation would be much easier and better, and a boat of suitable model and dimensions, and drawing, when loaded, but two feet, would be able to ascend the Colorado to the mouth of the Black Cañon with as much regularity and certainty as the steamboats now upon the river ply between the head of the Gulf and Fort Yuma. Although during high water the river experiences a great rise, the whole channel is not proportionally deepened. New bars commence at once to form, and at all seasons shoals are liable to be encountered. An iron stern-wheel steamer, one hundred feet long, of twenty-two feet beam, built full, and with a perfectly flat bottom, having a large boiler and powerful high-pressure engine, and drawing, when light, but twelve inches, would be the description of boat best adapted for the service.

Wood of excellent quality for the purpose of fuel can be obtained in abundance on the bank at short intervals between the mouth of the river and a point fifteen miles below the Black Cañon. It is principally mezquite, willow, and cottonwood.

CONNEXION OF THE HEAD OF NAVIGATION WITH UTAH.

A reconnaissance made from the foot of the Black Cañon towards the nearest point on the emigrant trail to Utah showed that a wagon road might be opened between the trail and the head of navigation. For sixteen miles, while passing through the gravel hills and ravines that cover the eastern slope of the intervening range of mountains, the country is somewhat rough, and a little work would be required to make a good roadway. but after reaching the summit there would

be no further difficulty. The distance from the river to the emigrant road is about forty miles.

TOPOGRAPHICAL DESCRIPTION OF THE REGION TRAVERSED.

The navigable portion of the Colorado runs nearly north and south. Near the Gulf the surface on either side is perfectly unbroken, the view being limited towards the west by distant spurs from the mountains of Lower California, and towards the east by the great Sonora desert. Further north broad valleys alternate with wild and rugged ranges of mountains, of volcanic origin, that cross the river in almost parallel northwest and southeast lines. The cañons formed by the passage of the river through some of these mountain chains are probably unequalled in beauty and grandeur by any similar formations. In the Black Cañon the deep and narrow current flows between massive walls of rock that rise sheer from the water for over a thousand feet, seeming almost to meet in the dizzy height above. The tortuous course of the river, as it winds through 'nese sombre depths, where the rays of the sun rarely penetrate, gives infinite variety to the majestic outlines of the overhanging masses, forming combinations whose colossal proportions and fantastic sublimity it would be impossible to figure or describe.

Above the cañon, in the vicinity of the mouth of the Virgen, is the most rugged and sterile region that I have ever beheld. Barren piles of rock, heaped together in chaotic disorder, and exhibiting on their broad surfaces no trace of vegetation, extend for miles in almost every direction. The volcanic upheavals, which have here their northern limit, appear to have experienced also their most violent action. Beyond, towards the north and east, the country is undisturbed, and a region is entered upon that presents totally new features and peculiarities. This is a vast table land, hundreds of miles in breadth, extending eastward to the mountains of the Sierra Madre, and stretching far north into Utah. To the extreme limit of vision immense plateaus rise, one above the other, in successive steps, the floors of the most elevated being from seven to eight thousand feet above the level of the sea. The Colorado and its tributaries, seeking the level of the low region to the southwest, have, by ages of wear and abrasion, cut their way through this huge formation, making cañons that are in some places more than a mile in depth. The mighty avenues of the main water-courses are the thoroughfares into which smaller but still giant chasms debouch, and these in turn have their own subordinate tributaries, forming a maze of yawning abysses, generally inaccessible, and whose intricacies it would be a hopeless task to attempt to unravel. Twice only, after long and difficult clambering down the sides of precipices and through walled approaches that seemed to be leading into the bowels of the earth, were the banks of the streams below finally attained. One place was on the Colorado itself, and the other near the mouth of one of its larger

tributaries. Except at the place of descent the cañon of the river, as far as it could be seen, showed no point of practicable ingress or outlet, and the appearance of the torrent, foaming and surging along its confined bed, left little room for doubt as to what would be the result of any attempt, such as has been sometimes suggested, to explore the river in boats from its sources above.

So numerous and so closely interlaced are the cañons in some portion of this singular region that they have displaced all but scattered remnants of the original plateau, leaving narrow walls, isolated ridges, and spires so slender that they seem to totter upon their bases, shooting up to an enormous height from the vaults below.

The natural surface of the country opposes insurmountable barriers to travelling in any fixed direction, and the aridity of the accessible portions of the table lands rendered the explorations difficult. Though the season of the year was the most favorable for finding water, much inconvenience was experienced from its scarcity, and it is doubtful whether during the dry months the examinations could have been prosecuted at all.

West of the Little Colorado belts of cedar and pine forests somewhat relieve the general aspect of barrenness, but travelling eastward, between that river and the towns of the Moquis Indians, the country becomes almost entirely a desert. The immense stretches of sandy soil are broken only by ridges of brilliant red and yellow marls, that intensify the heat and glare of the sun. The mirage ordinarily existing in such localities assumes generally the appearance of water, and is rendered peculiarly unpleasant from the known absence of that element over the whole region in question. Still further east the table lands begin to mingle with spurs from the Sierra Madre, the country becomes more broken and diversified, and the desert gives place to the habitable Navajo territory that borders the mountains west of the Rio Grande.

INDIAN TRIBES ENCOUNTERED.

The Indians living along the lower portions of the Colorado, comprising the Cocopa, Yuma, Chemehuevis, and Mojave tribes, have become tolerably well known from the narratives of persons who have within the last few years passed through their territory. Their numbers have been, I think, over estimated. Idle and inquisitive, they assemble *en masse* from far and near at the approach of strangers, and give an impression of a much larger population than really exists. The crowds that collected each day at the prominent points of the banks to watch the steamboat pass by appeared at first to present continual new sets of individuals, but it was found, after time had made familiar the portions of the faces that the paint and mud permitted to be visible, that the composition of the successive throngs was in a great measure the same. The Mojave tribe, which has been least exposed to intercourse with whites, appeared to be considerably the most numerous. Their symmetrical proportions and stalwart frames have obtained for them the reputation among all that have

been among them of being the finest race physically upon the continent.

The region east of the Colorado, along both the 36th and 35th parallels, is almost uninhabited. Inconsiderable bands of Tonto Apaches wander at some seasons over portions of it, and are occasionally encountered. Two small tribes were found living in the plateau cañons of the Colorado, corresponding in appearance to descriptions given of stragglers that had been met by parties crossing the country further south. There are but a few hundreds of them in all, and they are a diminutive wretched race. Their rude huts of boughs and stones are perched, like birds' nests, in crevices on the sides of the cliffs. Fish from the river, a scanty store of corn, wrung from some comparatively sunny spot in the dismal ravine, and what little game they can secure, constitute the resources which enable them to keep life in their bodies. Buried in the almost subterranean caverns, where alone they can obtain a permanent supply of water, most of them live and die entirely isolated from the world above. Their lonely and monotonous life seems to have deadened every faculty and emotion. It might have been supposed that the appearance of the first party of whites that had ever penetrated their retreats would have occasioned some sensation; but though the train of men and animals must have come down amongst them entirely unexpectedly, the novel spectacle excited no more apparent interest in the individuals encountered than in the toads that were hopping about among the rocks at their feet.

The Moquis Indians, whose residences border upon the country of the Navajoes, were the first large tribe seen after leaving the Colorado. There are seven towns, dignified by the early Spanish explorers with the titles of cities, and ruins of others that are now deserted. The tribe is much smaller than has been sometimes stated. The number of the population has been supposed to be about 7,000, but I should consider one-half of this an extravagant estimate. The towns are situated within a few miles of each other, and on the tops of isolated and precipitous hills. They are enclosed by walls of stone, and tolerably well constructed. The houses are built around an open court, and the only mode of entrance is by ladders that conduct to a small platform on the top of the exterior wall, upon which the doors and windows of the habitations open. Springs near the summits of the hills furnish a supply of water, and to provide against seasons of drought there are large stone reservoirs, exceedingly well made, placed in the hollows along the faces of the bluffs. Some of the towns are approached by flights of stone steps, and the steep ascent is laid out in neatly arranged terraced gardens; the masonry of the revetments being kept in excellent order and preservation. Orchards of peach trees, bearing an indifferent quality of fruit, grow on the hill sides. In the broad valley below are fields of cotton, corn, pumpkins and melons, whose cultivation, under great disadvantages of soil, climate and agricultural outfit, exhibits a degree of industry that in an Indian is truly remarkable. Both men and women labor in the field. They possess a considerable number of sheep,

nearly all of a jet black color, and some poultry. The women wear a long black gown of their own weaving, and the men variegated blankets, also of home manufacture. They are a shambling, ill-made race, with pleasant though homely faces, and are perfectly peaceful and inoffensive. They seem to suffer little molestation from more warlike tribes, which is due less to their own prowess than to the natural defences of their towns, whose commanding position and difficult approach afford security against both surprise and assault. The progress they have made in agriculture and manufactures helps to maintain their peaceful relations, Indians from all parts of New Mexico and from Utah having recourse to them for blankets, and in time of scarcity for provisions. Their unruly and powerful neighbors, the Navajoes, sometimes commit depredations upon them, but even with these an appearance of friendly intercourse is preserved. A curious fact was noticed, and illustrative of certain peculiarities of the Indian race, that the whole tribe do not speak the same language; the individuals in some of the towns absolutely professing to be unable to understand what is said by the residents of others.

A large portion of the Navajo territory was traversed, but its inhabitants have become so well known since the establishment of a military post in their midst as to require no particular description.

AGRICULTURAL VALUE OF THE COUNTRY EXPLORED.

A discussion of the agricultural value of the region explored, or its capability of sustaining a population would involve many considerations—some of an intricate character, a fair exposition of which would require a degree of detail much beyond the limits of the present communication. A few general facts and conclusions only can be stated.

During the explorations all of the lands upon the Colorado, from its mouth to the 36th parallel, and the greater portion of the region along both the 35th and 36th parallels, between the Colorado and the Rio Grande, was traversed. Much of the country had been previously explored, and a considerable portion of it—particularly some of the open valleys of the Great and Little Colorado rivers, and the Navajo country, pronounced by excellent authorities a good agricultural region—capable of a high degree of cultivation. Many facts were noticed during the examinations that tended to confirm this view, but certain unfavorable features were also apparent. Of the valleys upon the Colorado that of the Mojave Indians, which borders the 35th parallel, is by far the finest, and is perhaps the most promising looking region in the portion of New Mexico west of the Rio Grande. It was visited in the season of spring, which in that climate is during the month of February. The atmosphere was indescribably balmy and delicious. A pale transparent haze, of a peculiar delicate blue, which all must have noticed who have been in this valley, enveloped it with a softened glow. In brilliant contrast to the dark and frowning mountains on either side were groves of trees, with fresh and beautiful foliage, dotting the whole expanse of the

foreground. Fields of wheat, corn, beans, pumpkins, and melons, promising a luxuriant crop, met the eye in every direction. Comfortable houses and well built granaries, overflowing with the last year's stores, testified to the provident affluence of the inhabitants; and the robust appearance of the people themselves, with their well developed frames and solid glossy limbs, betokened a high degree of health, comfort and good living. That, for the number of Indians who now inhabit it, with their habits and mode of living, the country is an excellent one there can be no doubt. Whether it could ever be of much value to whites admits of a great deal.

The shifting of the bed of the Colorado would be a cause of great trouble in so narrow a valley. The changes occur with a rapidity and to an extent that can be scarcely appreciated by one who has not witnessed them. Having passed through the country in the spring of 1854, while accompanying the expedition of Lieutenant Whipple for the location of a railroad route along the 35th parallel, I had an opportunity of observing the effects of this action, which were so great as to justify the inference that every portion of the cultivable bottom lands is liable to be in turn overrun by the river. To the Indians, who have a certain community of property and interest and no valuable improvements to lose, this is a matter of no vital moment, but the white settler would be much discouraged from putting up buildings and fences, and digging the ditches necessary for purposes of irrigation, by the knowledge that at any day the river might direct its course through his premises.

Freshets occur at periodical intervals which subject large portions of the valleys to inundation. For four or five months of the year the rays of the sun are so intense and burning that no vegetation can withstand their influence, and during the very early spring, sometimes, when at midday there is an ordinary summer temperature, ice will be found at night. The growing season is thus rendered exceedingly short, and a single accident to a crop would, for that year, be without remedy. Seasons have occurred within a few years when the Mojaves have been subjected from this cause to great privations, and lost considerable numbers from actual starvation.

The composition of different portions of the soil was carefully examined by Dr. Newberry, the geologist of the expedition, and I am informed by him that, though much of it is so constituted as to be fertile, very large tracts in the higher parts of the valleys are so impaired by an excess of alkaline substances as to be comparatively valueless.

In forming an opinion of the value of the region some weight, too, should be attached to the fact that the races upon the river do not multiply. The records of the early Spanish explorers show a diminution rather than an increase of population since that period, and for this there is no assignable cause, unless it may be the incapacity of the country to sustain a large number of inhabitants. The Mojaves have had no communication with the whites, excepting when a wandering trapper or some exploring party has passed by their territory. A peaceful, yet a powerful people, and guarded on every side by

difficult mountains, they have suffered little from wars with other tribes. Their mode of life has conduced to the highest state of physical development. The marriage relation, as has been noticed by all who have been among them, is respected in more than an ordinary degree among Indians, and there seems to be no reason, except that above stated, why they should not have become a numerous nation.

The remarks made respecting this locality will apply, and perhaps in a stronger manner, to the rest of the country on the river, and also to the valley of the Little Colorado. The latter region abounds in ruins and vestiges of a former population, but is now uninhabited.

The remainder of the great area of territory examined presents, also, its discouraging features. The northern portion is much the worse. Besides the deserts that have been alluded to, in the timbered region itself are found broad tracts where the vegetation has become extinct, and the white and withered trunks are scattered like monuments over a vast cemetery of departed life. No indication of fire exists. The destruction has been gradual, and an impression is conveyed of some deadly rot slowly creeping over the surface of the country. Want of rain is undoubtedly the great cause of the evil. Near the abandoned ruins of several of the Moquis towns no water can now be found. This people, though exposed to no contact with whites, have partially dwindled away, and their ultimate fate, if the same meteorological condition continues, can be a question of little doubt.

Along the 35th parallel, within the limit of the volcanic disturbances, much of the country is better, and at some seasons of the year very attractive. After the melting snows of spring, and during the autumnal rains, a more smiling picture of green forest glades, sparkling streams, verdant hills, and wild flowers, the eye could not desire to dwell upon; and, excepting that the surface of the soil is in most places closely packed with lava rocks, there would seem to be a promising field for the agriculturist. Evidence, however, has been collected of seasons of drought so excessive as to render it doubtful whether more than a small portion of the country could ever be inhabited.

Over the whole of this region and that first alluded to remains of buildings and fragments of pottery are found, and this fact has been adduced as an argument to establish the present capability of the country to sustain a population; but there is an analogy between these mouldering ruins and the dead forest near by suggestive of a different conclusion, giving rise to a doubt whether the decay of one race of inhabitants might not have been induced by influences that would be effectual to prevent the introduction of another.

MINERAL RESOURCES OF THE COUNTRY.

The mineral resources of some parts of the country explored are considerable. The ranges of mountains that cross the navigable portion of the Colorado, which belong to the same system as those of

California and Sonora, are, like them, the repositories of a large amount of mineral wealth. They were examined by Dr. Newberry with as great thoroughness and care as the character of the expedition would permit, and found to be traversed by veins of such magnitude and richness as to give promise of a field of extensive mining operations. The metals, as far as observed, were gold and mercury in small quantity, silver, copper, and lead in rich and valuable deposits, and iron in the greatest abundance.

The close proximity of the treasures of these mountains to water transportation greatly enhances their value. A copper mine that promises to be highly successful is now being worked forty miles above Fort Yuma.

In the country of the upper Colorado the useful minerals found were iron, coal, rock salt, and marble. From their geographical position they have little pecuniary value, though their existence in that region is a fact of great scientific interest. On the sides of the cañons were splendid exposures of the stratified rocks which compose the great table lands of New Mexico, exhibiting all of the formations from the base of the series to the tertiary.

TRANSPORTATION FACILITIES OF THE COLORADO.

An estimate has been already presented to the department of the probable cost of transportation of stores to different points upon the Colorado. Fort Yuma is the only military post at present supplied in this way. The undertaking, while in its infancy, has been more expensive than it would be were the amount of business greater and the system fairly organized, but has proved in every respect superior to the slow, difficult, and expensive overland transportation. The increased amount of emigrant travel along the 35th and 32d parallels, the overland mail routes, the military post which must soon be required in the Mojave valley, and the mining operations, both upon the Colorado and in Arizona, will add largely to the business upon the river. Many distant points might profit by the facilities of approach it affords. Without entering into all of the details, which will be presented elsewhere, it may be stated that the amount of land transportation saved by sending supplies by this channel would be, to Salt Lake 700 miles; to Fort Defiance 600 miles; and to Fort Buchanan, near Tucson, 1,100 miles. A steamboat of the character previously described in ascending from the mouth of the river to the head of navigation would probably occupy from ten to twenty days, depending upon the season of the year and the stage of the water. There may be both delay and trouble in organizing a large transportation establishment in so new and in some respects so difficult a region, but I can see no reason why the Colorado should not at some day be used as the medium of communication with the greater portion of New Mexico, Eastern California, and Utah.

SUMMARY OF FIELD OPERATIONS.

The examination of the natural history of the region explored was zealously conducted by Dr. Newberry, whose name is well known in

connexion with such labors. Many new and interesting species of fossils, minerals, plants, and animals were collected. The geological results are of the highest interest. In making the collections Dr. Newberry was much assisted by Mr. H. B. Mollhausen, who also prepared a valuable series of illustrations of the more remarkable localities along the route.

Of the navigable portion of the river a careful and detailed survey was made, the labor being principally performed by Mr. C. Bielawski, of San Francisco. A set of meteorological and tidal observations and a topographical reconnaissance from Fort Tejon to Fort Yuma were faithfully conducted by Mr. P. H. Taylor, assisted by Mr. C. K. Booker.

The steamboat was taken to the mouth of the river, and there put together by the engineer, Mr. A. J. Carroll, of Philadelphia. The work was executed under peculiarly unfavorable circumstances, with surprising expedition, and with an ingenuity and zeal that I cannot too highly commend. During the trip up the river the post of pilot was filled by Captain D. C. Robinson, who had for many years lived upon the Colorado, and the successful ascent and descent of the river may be attributed to the energy, coolness, and thorough capacity with which he accomplished his duties.

A small party accompanied the land explorations, consisting of seven assistants and employés and a few Mexican packers, with an escort of twenty men, under the command of Lieutenant John Tipton, 3d artillery. To this officer I am indebted for valuable assistance in the astronomical and meteorological departments of the survey, and for the excellent order and discipline maintained safely throughout the trip among the individuals of his command.

The train while following the bank of the river and crossing the country was in charge of Mr. G. H. Peacock, of California, whose good care and experienced management brought it safely through a country of no ordinary difficulty.

The work of computing the astronomical positions and barometric altitudes is now in progress. Maps of the region explored are being constructed by Mr. F. W. Egloffstein, who accompanied the expedition as topographer, and who neglected no opportunity of obtaining, though often at the cost of great privation and exposure, an accurate knowledge of every portion of the region traversed.

During the explorations the health of all of the members of the party was good, and no accident of any kind occurred.

Respectfully, your obedient servant,

J. C. IVES,
1st Lieutenant Topographical Engineers,
Commanding Colorado Exploring Expedition.

A. A. HUMPHREYS,
Captain Topographical Engineers, in charge of Bureau
of Explorations and Surveys, War Department.

PRELIMINARY REPORT

OF

EXPLORATIONS

IN

NEBRASKA AND DAKOTA,

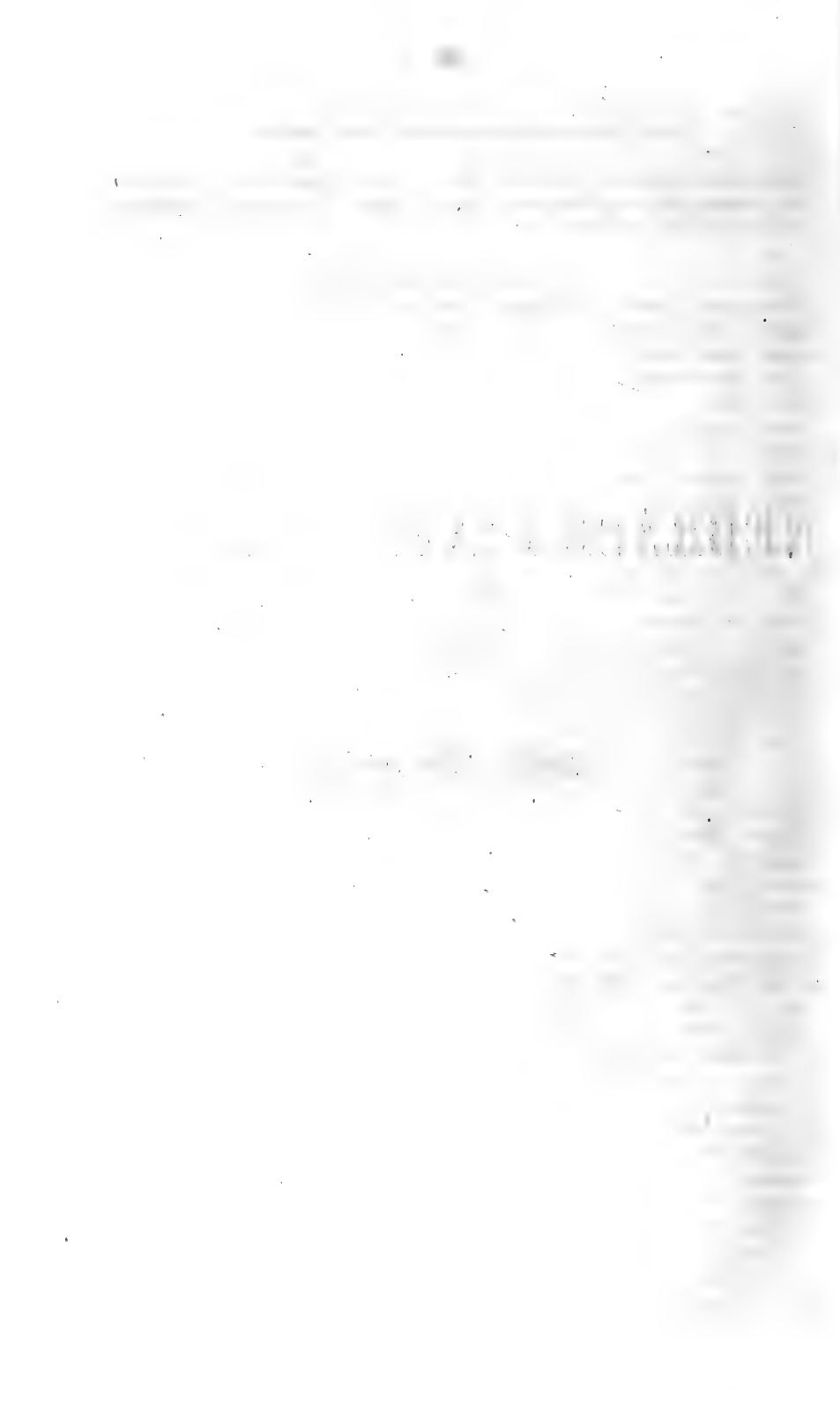
IN THE

YEARS 1855-'56-'57,

BY

LIEUT. G. K. WARREN, TOPOGRAPHICAL ENGINEERS, U. S. ARMY.

WASHINGTON:
1859.



EXPLORATIONS IN NEBRASKA AND DAKOTA.

Preliminary report of Lieut. G. K. Warren, Topographical Engineers, to Captain A. A. Humphreys, Topographical Engineers, in charge of Office of Explorations and Surveys, War Department.

WASHINGTON, D. C., November 24, 1858.

CAPTAIN: I have the honor to submit the following preliminary report on the results of the explorations conducted by me in Nebraska in the years 1855, '56, '57. This report is divided as follows:

1st. Routes explored, and main incidents affecting their direction and extent.

2d. Physical geography of Nebraska, character of the soil, and resources of the country.

3d. Remarks upon the climate and meteorology.

4th. A description of the principal rivers, and discussion of the merits of different routes. And

5th. An enumeration of the Indian tribes, military posts, and routes for military operations.

To the report is annexed a small map of Nebraska on a scale of 1 to 6,000,000, showing the main physical features of the country and the routes requiring further examination, as well as those already explored. The report is accompanied by catalogues of the paleontological, mineralogical, botanical, and zoological specimens collected on our explorations, prepared by Dr. F. V. Hayden, so as to show the localities where they were found. Much useful instruction as to the manner of making meteorological observations and collecting specimens in natural history was given to us by the officers of the Smithsonian Institution, and the secretary, Professor Henry, furnished us with rooms in which to store the collections and elaborate the results. A brief report, by Dr. Samuel Moffett, of the health of the party during the expedition in 1857, is also appended.

We have found it necessary to defer to a subsequent report the narrative and itinerary of the routes, the complete maps, profiles, and other illustrations, the tables of meteorological observations, and the results of our collections and observations in geology, botany, &c.

Some of the geological results have already been published by permission of the War Department in papers read by Dr. Hayden, Mr. F. B. Meek, and Dr. Joseph Leidy, before the Academy of Natural Sciences of Philadelphia. A letter prepared by me for the Hon. G. W. Jones, senator from Iowa, has also been published, accompanied by a small map of Nebraska, on a scale of 1 to 6,000,000. This map has also been colored so as to indicate approximately the geological formations, and in this shape is published with one of the papers prepared by Dr. Hayden in the proceedings of the Academy of Natural Sciences of Philadelphia.

A map of my explorations in Nebraska was ordered to be engraved by the United States Senate during the last session, and is now nearly ready for publication. In preparing this map I availed myself of all other explorations and surveys within the limits comprised by it, (in-

cluding thus some late unpublished maps kindly furnished from the Interior Department,) an acknowledgment of all of which is made thereon. It was necessary to indicate on this map a considerable portion of the country not examined by me in order to give it the greatest practical value, and to show the relation of the parts I have explored to those surrounding them. My design was to make the map a complete representation of all the region occupied by the Dakotas, and the best routes by which to approach and traverse it, and along which to conduct military operations to the best advantage; in other words, to make it a "military map of Nebraska and Dakota," which is the title I have given it. It is on a scale of 1 to 1,200,000, and embraces all the country from the 94th to the 106th meridian, between the 38th and 50th parallels. In its northeast corner is the Lake of the Woods, in the southeast Fort Leavenworth, in the southwest Pike's Peak, and in the northwest the junction of Milk river with the Missouri. A number of rivers are put down on this map which have never yet been explored, except at their mouths; these are the Knife river, Heart river, Cannon Ball river, and Moreau river. As the expeditions under my command have gone almost around the section through which they flow, and determined with a great degree of certainty that it is an open prairie, and have gained some knowledge of their lengths and directions from the Indians, they are probably represented with a considerable degree of exactness.

On the small map accompanying this report the southern branches of the Yellowstone river have also been represented with an approximation to correctness, by using information furnished by the expeditions of Captains Lewis and Clark, and Captain Bonneville, and also from sketches, &c., obtained by me from traders and trappers. This section of country, however, has much practical importance in relation to routes through it by which to reach Utah from the navigable parts of the Missouri and Yellowstone, and deserves a thorough exploration. This examination I have always had a great desire to make, and in my previous expeditions have taken much pains to ascertain the best means of conducting it. In this I have been fortunate in meeting with Mr. James Bridger, Mr. Alexander Culbertson, Mr. Robert Campbell, and others well acquainted with the character of the country from personal experience, and have the assurance of the services of Mr. Bridger if the exploration should be ordered.

On account of the great distance of the region to be examined from the settlements it is necessary to provide the expedition with the means for remaining two summers, the intervening winter to be passed at some suitable point on the Yellowstone or Big Horn rivers. It would be difficult for an expedition to do more than go and return in the same season, so that then little or no time would be allowed to explore. The country is principally occupied by the Crow Indians, and, as I know them to be friendly, I think a military escort can be dispensed with, which is a material consideration under the present excessive requirements of the military service. The method I propose instead is, to go well provided with goods and presents by which to purchase of the Indians permission to pass through the country and to employ them as guides. In this way much expense can be prevented,

and, with prudent management, danger to the expedition can be avoided ; besides, valuable information will be gained from the Indians which would be withheld if we entered their country in a hostile attitude.

The expedition should be completely organized and equipped for the field by the 1st of May, 1859, and remain in the field until the 1st of December, 1860, nineteen months.

There should be thirty men, at \$30 per month, and eight assistants, as topographers, collectors, guides &c., at \$125 per month. This would require \$38,000. Their provisions would cost about \$7,000. Animals and outfit \$10,000. Indian goods \$4,000. Contingencies \$3,000. Total \$60,000. Of this amount about \$35,000 would be required the first year. The bulk of the stores and goods required should be contracted for, to be delivered at Fort Laramie or the Platte Bridge.

The expedition itself should proceed by the Missouri river to Fort Pierre, where the necessary animals for a pack train should be assembled. At this point we should meet with some of the principal men of the Dakotas, and overtures should be made to secure their assent to our proceeding westward up the Shyenne and its North Fork, and thence to the source of Powder river, thus exploring a new route. Should this consent be withheld, and it should not be considered safe to proceed without it, the party could take the route by way of White river to Fort Laramie and thence to the source of Powder river. The exploration should then be conducted along Powder river to its mouth, thence up the Yellowstone to the mouth of Tongue river, up which stream a detachment should be sent to its source. The remainder of the party should ascend the Yellowstone to the mouth of Big Horn river, and up this latter stream to the point where it leaves the mountains, where it should be joined by the detachment which explored Tongue river.

The approach of winter might require the party to pass that season in this neighborhood, or, if time sufficed, the expedition might ascend the Big Horn river to Wind river, where a very favorable wintering place could be found. Either of these places would be sufficiently convenient to the supplies on the Platte. Under circumstances not foreseen it might be best for the expedition to winter near Fort Laramie.

The next season should be spent in examining the mountain region about the sources of the Yellowstone and Missouri, to ascertain the character of the routes leading south and west from the navigable parts of these rivers. On returning, one portion should descend the Missouri, the other the Yellowstone, to their junction, where a Macinac boat should be in readiness, by which all could proceed to the settlements.

These explorations would determine the practicability of all the routes marked on the accompanying map as deserving examination, and would require much activity on the part of those conducting them. Pack trains should alone be used, as wagons greatly retard the operations of a party and vastly increase the difficulty of defending it against attack. The abundance of game in much of this region would render

it unnecessary to provide the usual quantity of bread and bacon, which always make the bulk of the provisions required.

The party must be well prepared for defence against war parties, and it would be desirable to arm each man with a revolver, and about three-fourths of them, in addition, should have a double-barrelled gun, one rifled, the other smooth. This is a most effective gun either for hunting or fighting.

Copies of my instructions from the Hon. John B. Floyd, Secretary of War, dated May 6, 1857, and from Brevet Brigadier General W. S. Harney, dated June 3, 1856, are transmitted herewith.

Very respectfully, your obedient servant,

G. K. WARREN,

Lieutenant Topographical Engineers.

Captain A. A. HUMPHREYS,

Corps of Topographical Engineers,

In charge Office Explorations and Surveys.

WAR DEPARTMENT,

Washington, May 6, 1857.

SIR: Under the appropriation "for surveys for military defences, geographical explorations, and reconnaissances for military purposes," you will organize an expedition to ascertain the best route for continuing the military road between Fort Snelling and the mouth of the Big Sioux to Fort Laramie and the South Pass, by way of the Loup Fork of the Platte; to make also such explorations in the Black Hills, about the sources of the Sheyenne and Little Missouri rivers, as the time and means will permit; and to examine the Niobrara or l'Eau qui Court river, upon your return route, for the purpose of ascertaining its character and resources and the practicability of locating a road along it, leading from the Missouri river to the South Pass, or from Fort Randall to Fort Laramie.

The sum of twenty-five thousand dollars is set apart from the appropriation to defray the expenses of the expedition, which amount your expenditures must not exceed.

The commanding general of the Department of the West will be directed to detail an escort of thirty enlisted men of the infantry, under the command of a second lieutenant, who will report to you for duty.

Transportation for the provision and equipage of the escort, their subsistence, and their necessary ammunition, will be furnished, respectively, by the Quartermaster's, Commissary, and Ordnance Departments.

Upon the proper requisitions, officers of the Quartermaster's and Commissary Departments at the military posts near the routes pursued by the expedition will furnish, as far as practicable, all necessary supplies for it, which, when required for the civil employés, shall be paid for at cost prices at the places of delivery, from the appropriation for the survey.

Twenty Colt's revolvers, of the navy pattern, with belts, holsters, and the necessary ammunition, will be furnished by the Ordnance Department; those lost or damaged being paid for out of the appropriation for the survey.

All other arms and ammunition for the civil employés (guides, hunters, herders, &c.) of the expedition will be paid for from this same appropriation.

You are authorized to employ as assistants—

A topographer, at a salary not to exceed	\$130 per month.
One assistant topographer, at a salary not to exceed	100 “
An assistant astronomer, at a salary not to exceed...	125 “
A physician and geologist, at a salary not to exceed	125 “
An assistant physician and geologist, at a salary not to exceed.....	100 “
A meteorologist, at a salary not to exceed.....	60 “

And to pay their actual travelling expenses to and from the field of operations.

You will procure your employés equipment, supplies, &c., at those points which appear to insure the most economical and effective organization for your party, and prepare to take the field at the earliest possible moment. While in the field attention will be given to ascertaining everything relating to the agricultural and mineralogical resources of the country, its climatology, its topographical features, and the facilities or obstacles which these latter offer to the construction of rail or common roads.

You will communicate with the department through the office of Explorations and Surveys, in charge of Capt. A. A. Humphreys, Corps Topographical Engineers; and to this office you will make the reports and returns required by regulations of an officer of engineers in charge of a work or operation, and such other reports, transmitted as often as the means of communication will allow, as will keep the department apprised of all your movements, and the progress of the expedition under your charge.

On the completion of the field duty, you will return, with your assistants, to Washington, and there prepare the maps and reports necessary to a full exposition of the results of the expedition.

Very respectfully, your obedient servant,

JOHN B. FLOYD,
Secretary of War.

Lieut. G. K. WARREN,
Corps Topographical Engineers.

SPECIAL ORDERS No. 26.

HEADQUARTERS SIOUX EXPEDITION,
Camp near old Fort Lookout, Missouri River, June 3, 1856.

I. As it is important to obtain reliable information of the Missouri river, from Fort Pierre to some point above the mouth of the Yellowstone, near which Governor Stevens' route strikes it, Second Lieutenant Gouverneur K. Warren, Topographical Engineers, is assigned

to this duty, and will proceed with his party by the steamer St. Mary's to the point above indicated.

On his return, Lieutenant Warren will procure a sufficient number of Mackinac boats, for the transportation of his party, stores, &c., to enable him to effect a thorough examination of this part of the river.

II. The commanding officer of the 2d infantry will select an efficient party from his regiment, consisting of two non-commissioned officers and fifteen men, to report to Lieutenant Warren as his escort. They will be furnished with three months' provisions, equipage, &c.

III. The assistant quartermaster at Fort Pierre will furnish the necessary transportation, and such supplies as Lieutenant Warren may be entitled to from his department, for the proper execution of these instructions.

By order of Brevet Brigadier General Harney.

A. PLEASANTON,

Captain 2d Dragoons, Acting Assistant Adjutant General

REPORT.

CHAPTER I.

Routes explored, and main incidents affecting their extent and duration.

In presenting the following report of explorations in Nebraska, made by me in the year 1857, I shall include also my previous reconnaissances in that Territory in the years 1855-56, while attached to the staff of Brevet Brigadier General W. S. Harney, commanding the Sioux expedition. As, at this time, a complete narrative of these cannot be made, I shall only mention the routes pursued and the nature of the examination, and then give what I consider the most prominent results.

A report of the explorations made in 1855, and map of the routes pursued by the Sioux expedition, have already been published by the United States Senate in a small document called "Explorations in the Dacotah Country." During that year routes were examined from Fort Pierre to Fort Kearney; from Fort Kearney to Fort Laramie, along the Platte river; from Fort Laramie to Fort Pierre; and from Fort Pierre to the mouth of the Big Sioux river.

In 1856 I started from St. Louis for Fort Pierre, in the middle of April, accompanied by my assistants, Messrs. W. H. Hutton, J. H. Snowden, and F. V. Hayden, on board Captain Throckmorton's steamboat Genoa. During our passage up the Missouri we made a careful sketch of the river above the southern boundary of Nebraska by means of compass courses, and distances estimated from the rate of travel of the steamboat, and by astronomical observations for latitude. The elevated position of the pilot-house of the steamboat, which the politeness of the captain allowed us to occupy, afforded advantages for gaining a knowledge of the river, the extent of the sand bars, and

the size and quantity of timber on the banks, the nature of the bottom lands as regards marshes, &c., not equalled by those of any other means of reconnaissance, and the topographer at the same time could avail himself of the extensive and accurate knowledge of the pilot. Our observations, by means of forward and back sights, showed us that the effects of local attraction on the compass by the iron on the boat were not important, and the checks on the estimated distances, afforded by the results of observations for latitude, proved that these estimates were very accurately made by Messrs. Hutton and Snowden, who, by turns, prepared the sketch of the river.

As far up as the mouth of James river our advance had been quite rapid, the river being at a good stage; but a short distance above that point we encountered a sudden and heavy freshet in the river, (produced by rains,) with a current so rapid that our boat was unable to advance against it. From this cause we remained tied up to the bank a whole day. As soon as the river began to fall, the velocity abated, and we proceeded on the voyage. So sudden, however, was the subsidence of the flood that, in five days after we had escaped the embargo of too much water, we found ourselves aground and drawing several inches more water than there was anywhere on the bar, which stretched across the river. This occurred to us near the first Cedar island.

Under these circumstances, being anxious to reach Fort Pierre as soon as possible, as was also Captain Frost, (who was sutler at the fort, and whose goods were the principal freight of the boat,) we determined to leave the boat and proceed on foot to the dragoon camp, at the mouth of American Crow river, about 80 miles distant. Our means of transportation were two horses, the property of Colonel Lee, 2d infantry, and Lieutenant Colonel Andrews, of the 6th infantry, which carried our blankets and provisions, and we were accompanied by a Mr. Moore and two men. On arriving opposite to the dragoon camp on the evening of the third day's travel, we were informed that there was no boat to bring us across. We stayed on the bank of the river that night, and the next morning renewed our signals to communicate with the camp. These, however, failed to attract attention to us, and our provisions being short we were obliged, though much wearied by our journey on foot, (there having been a cold rain one day and night,) to attempt to reach Fort Pierre, 80 miles distant. This we accomplished in three days, and arrived there on the 20th of May, completely exhausted, having subsisted mainly on the birds killed with our shot guns. The journey gave me an opportunity of viewing the country and its appearances a few miles back from the Missouri.

The steamboat having landed a portion of her freight at the place where we left her, reached Fort Pierre three days after us. On my arrival all the tribes of the Dakotas west of the Missouri, except the Sichangus and Ogalalas, were assembled in council, and a treaty of peace was made with them by General Harney, which terminated the Sioux war.

Instructions were now given me by General Harney to proceed with my party in the American Fur Company's boat to the mouth of the Yellowstone, and as far above as she should ascend, and to return by

means of a Mackinac boat, and carefully examine all points on the river to determine their suitability as sites for military posts, and to obtain such other information as we should be able with regard to the country. An escort of fifteen men and two non-commissioned officers of the 2d infantry were placed under my command. We left Fort Pierre in the American Fur Company's boat "St. Mary," Captain Labarge, on the 28th of June, and reached Fort Union on the 10th of July. The boat landed most of her stores, and then proceeded to a point about 60 miles above the mouth of the Yellowstone and discharged the balance.

While ascending the river, the sketch of it was taken above Fort Pierre, as it had been below, by Messrs. Hutton and Snowden, and observations were made by me for latitude. At Fort Union a 16-inch transit was set up, and observations taken during a whole lunation; but owing to the cloudy condition of the nights during the time, and the shortness of the nights themselves, only two sets of observations were obtained on the moon and stars. The result of these gave the longitude of that post $104^{\circ} 02'$, with a limit of error of about $10'$.

While at Fort Union we saw the Assinniboin Indians.

Having ascertained that a Mackinac boat could not be prepared for me before the 1st of September, I determined to make an examination of the Yellowstone during the month of August; and in carrying this out I was fortunate in being able to purchase the means of land transportation from Sir St. George Gore, who was returning from an extensive hunting excursion on the waters of the Yellowstone and its branches. We left the mouth of the Yellowstone July 25, and, travelling leisurely up the left bank, reached a point one hundred miles from its mouth, beyond which it was impossible to advance with wagons along the valley of the Yellowstone without crossing to the opposite banks. Here we made a camp with the main body, and with a party of seven I proceeded, with pack animals, over a very difficult country (known as the Bad Lands of the Yellowstone) to the mouth of Powder river, thirty miles further.

This was the furthest point up the Yellowstone that I intended to proceed, and I was anxious to reach it and to fix its position, as being a good and certain point with which any future reconnaissance could connect. From the appearance of Powder river at the mouth, no one would suppose the stream to be of the length it really is, and I was not surprised at Captain Clarke not having done so on his voyage down the Yellowstone in 1806. On returning to our wagon camp, we all travelled a short distance down the Yellowstone to a convenient point, where we made a boat eighteen feet long and five feet wide, by stretching the skins of three buffalo bulls over a frame made of small cotton-wood and willow trees. With this vessel a small party navigated the Yellowstone to its mouth, carefully mapping the islands and bends of the river. The wagons and land party returned to the Missouri by travelling over nearly the route by which they ascended.

We enjoyed the greatest abundance of large game of all kinds while on the Yellowstone river.

On reaching Fort Union again we found our boat nearly ready,

and, all our arrangements being completed, we left that place on the 1st of September. A small party conducted the animals along the shore on our journey down the Missouri, generally camping each night with the boat party. Halts of two or three days were made at all interesting localities, and map sketches were made several miles up all the streams flowing into the Missouri; and the map of the Missouri was also verified. These sketches, on a scale of one and a half inch to a mile, are on file and convenient for reference in this office.

Thermometer and barometer observations were made throughout the period of the examinations of the year 1856. Dr. Hayden was indefatigable in his efforts to develop the geology of the region traversed, and some of the results have already been published, by permission of the War Department, in the Proceedings of the Academy of Natural Sciences in Philadelphia. A very extensive collection was also made in zoology.

We reached Fort Pierre on our return on the 2d of October, at which place our animals were sold, and most of the soldiers returned to their respective companies. A few accompanied us as far as the mouth of the James river. We reached Sioux City on November 15, and fortunately found a steamboat there, by means of which we proceeded with our effects to St. Louis, and thence by railroad to Washington. The cost of this expedition to the United States was about \$10,000.

No special report has yet been made by me on the results of this year's exploration. The maps were about completed, and the material in the process of elaboration, when I was assigned to the command of another exploration by the War Department, a brief account of which I shall now proceed to give.

I received my instructions from the Hon. John B. Floyd, Secretary of War, May 7, 1857, the general terms of which were to make the necessary examinations to determine the best route for continuing the military road between Mendota and the Big Sioux westward to Fort Laramie and the South Pass. Thence to proceed northward and make such examinations on the Black Hills as my time and means would permit, and to return by the valley of the Niobrara, and make a careful examination thereof. I was assisted in the examination by Messrs. J. H. Snowden and P. M. Engel, as topographers; Dr. F. V. Hayden, as geologist; W. P. C. Carrington, as meteorologist; Dr. S. Moffett, as surgeon; and Lieut. Jas. McMillan, commanding the escort.

The escort, numbering twenty-seven men and three non-commissioned officers, under Lieut. McMillan, all of the 2d infantry, was directed to meet me at Sioux City, transportation for it being furnished by the quartermaster's department. Transportation for the remainder of the party was assembled at Omaha City as soon as possible; and on the 27th of June, under the charge of Mr. Snowden, set out for the rendezvous at the mouth of Loup Fork.

Accompanied by Mr. Engel, I then proceeded to Sioux City, where we found the escort had been awaiting us several days on the Big Sioux river. Through some misunderstanding there were no teamsters furnished for the wagons of the escort; and the mules, from a

disease of the hoof, and the wagons, and especially the harness, from long use, were of very inferior quality. It occupied me six days in getting the train in travelling condition, which was only done by abandoning one wagon and a large supply of stores for the escort. During this time a rumor* reached there of a fight having taken place between the soldiers and the Shyennes at Ash Hollow, in which a hundred of the former were killed. Twelve of the soldiers of the escort, tempted by the high prices of labor in this vicinity, and tired of the toils and privations of campaigning, deserted as we were about to set out, and some white thieves who infested the neighborhood of Sioux City carried off two of my best horses. These losses occurring in a civilized community, where we supposed ourselves among friends, were quite annoying, and gave rather unpleasant forebodings of what might occur to us when we should come among our enemies, the Indians.

We set out from Sioux City July 6, and, taking a direct course, joined the other party on the Loup Fork, being 11 days in going 110 miles. The route was heavy from frequent rains, all the ravines being filled with water, and the most insignificant rivulet requiring preparation, on account of the soft nature of the soil, before a wagon could cross it. We had to make one bridge (over Middle creek) about 30 feet long, and construct a raft with which to cross the Elk Horn.

The united party now set out on their journey westward on the Loup Fork, meeting with no serious difficulties on the route (except the quicksands in crossing the main north branch) till we came to within 50 miles of the source of the stream. Here the river became shut up in a gorge impassable for wagons, and we were forced out among the difficult sand hills which border the bluffs and which extend north to the Niobrara and south nearly to the Platte. They also extend much further east, but they occasioned us no difficulties till we were forced to leave the bank of the stream.

We finally came to the source of the Loup Fork, and from this point endeavored to proceed as directly as possible north to the Niobrara, for we were somewhat apprehensive of losing everything, for want of water, by endeavoring to push our way westward through the Sand Hills. These hills, however, were so impracticable for wagons that we were forced much more to the west than we desired, and one day we were unable to find water to camp by. There are numerous lakes in this Sand Hill country, but many of them are too much impregnated with salts to be wholesome. Some of these latter our animals drank out of without injury. On reaching the longitude of $102^{\circ} 30'$ we had the good fortune to find an open stretch of country with a large well marked lodge trail leading between the Platte and Niobrara, which, in one day's travel northward, brought us to the Niobrara. We now proceeded rapidly over an easy route to Fort Laramie.

During the journey there had been considerable sickness in the camp from fevers, and one of the men was so near the point of death that a halt of several days was made for his benefit. Dr. Moffett also became so ill as to require a delay of one or two days. These neces-

* This rumor was without foundation, as it afterwards appeared.

sary stoppages, the difficulties of the route, rainy weather, together with my being obliged to leave so much of our provisions behind at Sioux City, reduced our supplies to a small amount, and for nearly two weeks we were without sugar or coffee. We had also been very much disappointed in the amount of game; and though the country gave evidence of having recently been occupied by large herds of buffalo, only a few bulls were seen. During the early part of the journey mosquitoes were abundant, and allowed our animals no rest at night, and immense numbers of flies attacked them by day. These insects, combined, exhausted and worried the animals more than the labor they performed, and the lives of one or two were saved only by covering them with grease and tar to keep the flies and mosquitoes away.

At Fort Laramie we entirely refitted the party, which took us a long time, on account of everything being required for the Utah expedition. It gives me great pleasure to state that the commanding officer, Colonel Hoffman, and the acting quartermaster, Lieutenant Higgins, gave me all the facilities at their command. Owing to the great number of animals that graze in the neighborhood the grass was nearly eaten off, and our animals recruited very little during our stay there. While there I succeeded in getting several sets of observations for moon culminations, which determined the longitude to be $104^{\circ} 30'$ with a limit of error of about $4'$. Dr. Hayden and Mr. Engel also made an excursion to Laramie peak, which they ascended.

The party, on leaving Fort Laramie, was divided into two parts, as, owing to the lateness of the season, it was impossible to accomplish all the objects of the expedition by keeping together. Though in doing this I subjected each portion to the possibility of being defeated by the Indians, I deemed the case to justify the risk. The wagons were, half of them, turned in to the quartermaster, and the remainder, with the escort under Lieutenant McMillan, were to proceed down the Niobrara, and await me in longitude $101^{\circ} 30'$. Mr. J. H. Snowden went with this party to make the topographical reconnaissances; Dr. Moffett also accompanied it. My own party consisted of Dr. Hayden, Mr. Carrington, and Mr. Engel, and we had with us 17 men as packers, &c., and Mr. Morin as a guide and interpreter. Our supplies were packed on mules.

Setting out from Fort Laramie on the 4th of September, we proceeded direct for the Black Hills, *via* Raw Hide butte, Old Woman creek, the south fork of the Shynenne, and Beaver creek; up a branch of this last we entered the Black Hills. We continued north to the vicinity of the Inyan Kara, (or the peak which makes the mountain,) a remarkable high basaltic peak, one of the highest of these mountains, and so far to the north that we had a full view of the prairie beyond.

Here we were met by a very large force of the Dakotas, who made such earnest remonstrances and threats against our proceeding into their country that I did not think it prudent for us, as a scientific expedition, to venture further in this direction. Some of them were for attacking us immediately, as their numbers would have insured success; but the lesson taught them by General Harney, in 1855,

made them fear they would meet with retribution, and this I endeavored to impress upon them. We were at the time almost in sight of the place where these Indians had plundered Sir George Gore in 1856, for endeavoring to proceed through their country, and one of them was actually mounted on one of his best horses taken at that time. Sir George Gore's party was only about half as numerous as mine; but there were a number of my party which I had picked up at Fort Laramie on whom we placed very little reliance.

The grounds of their objections to our traversing this region were very sensible, and of sufficient weight, I think, to have justified them in their own minds in resisting; and as these are still in force for the prevention of the passage of any other party of whites not large enough to resist successfully, they are of sufficient importance to be repeated here. In the first place, they were encamped near large herds of buffalo, whose hair not being sufficiently grown to make robes, the Indians were, it may be said, actually herding the animals. No one was permitted to kill any in the large bands for fear of stampeding the others, and only such were killed as straggled away from the main herds. Thus the whole range of the buffalo was stopped so that they could not proceed south, which was the point to which they were travelling. The intention of the Indians was to retain the buffalo in their neighborhood till their skins would answer for robes, then to kill the animals by surrounding one band at a time and completely destroying each member of it. In this way no alarm is communicated to the neighboring bands, which often remain quiet almost in sight of the scene of slaughter.

For us to have continued on then would have been an act for which certain death would have been inflicted on a like number of their own tribe had they done it; for we might have deflected the whole range of the buffalo fifty or one hundred miles to the west, and prevented the Indians from laying in their winter stock of provisions and skins, on which their comfort if not even their lives depended. Their feelings towards us, under the circumstances, were not unlike what we should feel towards a person who should insist upon setting fire to our barns. The most violent of them were for immediate resistance, when I told them of my intentions; and those who were most friendly, and in greatest fear of the power of the United States, begged that I would "take pity" on them and not proceed. I felt that, aside from its being an unnecessary risk to subject my party and the interests of the expedition to, it was almost cruelty to the Indians to drive them to commit any desperate act which would call for chastisement from the government.

But this was not the only reason they urged against our proceeding. They said that the treaty made with General Harney gave to the whites the privilege of travelling on the Platte and along White river, between Fort Pierre and Laramie, and to make roads there, and to travel up and down the Missouri in boats; but that it guaranteed to them that no white people should travel elsewhere in their country, and thus frighten away the buffalo by their careless manner of hunting them. And finally, that my party was there examining the country to ascertain if it was of value to the whites, and to dis-

cover roads through it, and places for military posts; and that having already given up all the country to the whites that they could spare, these Black Hills must be left wholly to themselves. Moreover, if none of these things should occur, our passing through their country would give us a knowledge of its character and the proper way to traverse it in the event of another war between themselves and the troops. I was necessarily compelled to admit to myself the truth and force of these objections.

The Indians whom I first met were the Minikanyes, to the number of forty lodges, near whom, as they were very friendly, we encamped.* They were soon joined by the warriors of a large camp of Unkpapas and Sihaspas, and our position, which was sufficiently unpleasant in the presence of such a numerous party of half-avowed enemies, was rendered doubly so by a storm of sleet and snow, which lasted two days and nights, and against which we had but little protection.

A young Indian, who had accompanied us from Fort Laramie, considered the danger to us so imminent that he forsook our camp and joined his friends, the Minikanyes.

Under these embarrassing circumstances my associates evinced the most resolute bravery and determination to abide the result like true men.

I consented to wait three days without advancing, in order to meet their great warrior, Bear's Rib, appointed first chief by General Harney's treaty, merely changing our position to one offering greater facilities for defence. At the expiration of the time, Bear's Rib not making his appearance, we broke up camp, and, travelling back on our route about forty miles, struck off to the eastward, through the southern part of these mountains. The point where we turned back is well marked by the Inyan Kara peak, whose position was fixed by us.

After we had proceeded two days on our journey eastward, we were overtaken by Bear's Rib and one other Indian who accompanied him. He reiterated all that had been said by the other chiefs, and added that he could do nothing to prevent our being destroyed if we attempted to proceed further. I then told him that I believed he was our friend, but that if he could do nothing for us, he had better return to his people, and leave us to take care of ourselves, as I was determined to proceed as far as Bear butte. After a whole day spent in deliberation, he concluded to accompany us a part of the way, and he said he would then return to his people and use his influence to have us not molested. In return for this, he wished me to say to the President and to the white people that they could not be allowed to come into that country. That if the presents sent were to purchase such a right, they did not want them. All they asked of the white people was, to be left to themselves and let alone. That if the presents were sent to induce them not to go to war with the Crows and their other enemies, they did not wish them. War with them was not only a necessity but a pastime. He said General Harney had told them

* I am much indebted to the influence of Major Twiss, the Indian agent near Fort Laramie, for his efforts to give the Dakotas a favorable opinion of my expedition, and to secure us a friendly reception.

not to go to war, and yet he was all the time going to war himself. (Bear's Rib knew that when General Harney left the Sioux country he had gone to the war in Florida, and was at the time in command of the army sent against the Mormons.) He said, moreover, that the annuities scarcely paid for going after them; and that if they were not distributed to them while they were on their visit to the trading posts, on the Missouri, to dispose of their robes, they did not want them.

(It is a fact, that for several years, owing to this cause, these Indians have not come in for their goods at all.)

He said that he heard that the Ihanktonwans were going to sell their lands to the whites. If they did so, he wished them informed that they could not come on his people's lands. They must stay with the whites. Every day the Ihanktonwans were coming there, but were always turned back.

Whatever may have been Bear's Rib's actions after leaving us, it is certain we saw no more Indians in the Black Hills. We completed our reconnaissance along the eastern portion of these mountains as far as Bear peak, which forms another convenient and accurate point with which any future reconnaissance may connect with our own. We also visited the north fork of the Shyenne, in this vicinity. On our return we took a southeast direction, striking the south fork of the Shyenne at the mouth of Sage creek. We then proceeded up the south fork to French creek; thence southeast, through the Bad Lands, to White river; thence along the sources of White Clay creek and Porcupine creek; and thence to the Niobrara, striking it in longitude $102^{\circ} 03'$.

We found the party under Lieutenant McMillan about forty miles below where we struck the river, and eighty miles below where we had first reached it on our journey westward in August. This intervening distance had been carefully mapped by Mr. Snowden, and he had made several excursions at different places to examine the country, as I had directed. Lieutenant McMillan's march down the river thus far had not been made without much wordy opposition from the Brule Dakotas, much of the same kind as that I have related as having been said to me in the Black Hills. On finding that he was determined to proceed, the chief, Little Thunder, sent four of his principal men to accompany them, which they did for some days. At a subsequent time, twenty-two warriors charged into the camp, thinking the party was a trading expedition. Their insolence was checked by Lieutenant McMillan's threatening to fire on them; whereupon they entered their usual protest against the party's proceeding further, and the next day all withdrew. The last twenty miles of Lieutenant McMillan's route was through difficult sand hills bordering the river, the stream itself being so shut in by high precipitous ridges that he was unable to travel along it.

We now found the route exceedingly laborious for wagons on account of the sand hills, which continue to the mouth of Rapid creek. The character of the immediate valley of the Niobrara precluded the wagons from travelling along it; so, while Mr. Snowden mapped the route of the train, Mr. Engel travelled along the river, sometimes on one side and sometimes on the other, and made a map of it. Even he,

though riding a mule, found it difficult to keep up in this way with the wagons, which slowly wound their way through and over the sand hills. Our camps at night were here always on the main river. After passing the Rapid creek the sand hills gave us no longer any trouble, (except for about twenty miles on the point between the Niobrara and Keya Paha,) but the ravines and precipices still prevented the wagons from travelling within from five to eight miles of the Niobrara, and here Mr. Engel continued the sketch as before. Dr. Hayden also travelled along the immediate banks of the river, examining the character of the rocks and collecting fossils.

On reaching the mouth of the Keya Paha, the main party, with the wagons, proceeded direct to Fort Randall, and a separate party, under Mr. Engel, travelled down the Niobrara to its mouth, completing the examination of that stream. It was my intention for Dr. Hayden to accompany him, but on arriving at the place of separation we found the same geological formation and characteristics as we knew to exist at the mouth; and as the intervening distance was only sixty miles, he did not deem it necessary to go over it.

Fort Randall was reached on the 1st of November, and the escort was returned to the regiment. We were most hospitably received by Major Day, commanding the post, and the other officers of the 2d infantry, and I take this occasion to acknowledge my indebtedness to this regiment for the aid and protection they have afforded me in all my explorations.

Two sets of observations for moon culminations were obtained here, but cloudy weather prevented more. The longitude, as calculated from them, is $98^{\circ} 34'$, with a probable limit of error of about $8'$.

The party set out from Fort Randall on the 7th of November, and surveyed the route to Sioux City, which was reached on the 16th. The season being far advanced, no steamboat was expected, and the river was full of floating ice. The weather, as we travelled on towards Fort Leavenworth, became very severe, and the river became frozen over as far down as St. Joseph's. During this time we made rapid progress, but a mild spell of weather coming on made the road so heavy that with the greatest exertion we hardly accomplished ten miles a day. During this time the health of the party suffered severely from influenza. We reached Fort Leavenworth on the 4th of December, and were fortunate enough to meet there with a steamboat, by which we proceeded to St. Louis, and thence by railroad to Washington.

CHAPTER II.

Physical geography of Nebraska; character of the soil and resources of the country.

Though my personal examinations have nowhere extended west of the 106th meridian, there are certain points west of it to which I would direct attention. The positions of the Missouri and Yellowstone west

of this meridian and north of the 46th degree of north latitude have been well examined by Lewis and Clark and under Governor Stevens, and the valuable information they obtained is widely known. The section, however, between the 46th parallel in the north and the 43d in the south, the 106th meridian in the east, and the dividing line between the waters of the Pacific and the Atlantic in the west, is comparatively unknown, except from the accounts afforded by trapping parties. The information given of it on the map of Lewis and Clark is derived from this latter source; as is also that on Colonel Bonneville's map, published with "Irving's" work on "Adventures in the Rocky Mountains," &c.; and these are our most authentic sources of information. These maps have been generally disregarded by subsequent map-makers; and previous to the map I compiled for the Pacific Railroad Office, there have been no mountains represented about the source of the Yellowstone. From inquiries I made of trappers in 1855, I became convinced of the existence of these mountains, and represented them accordingly, endeavoring to combine the information on Lewis and Clark's map and Bonneville's map with that which I had procured from traders and trappers. In doing this, I represented the Big Horn mountains perhaps too far to the west, as they are perfectly visible from the summit of the Inyan Kara peak, in the Black Hills.

Leaving out of consideration for the present the smaller detached mountain masses, and beginning with the main range of the Rocky mountains, on the 49th parallel, we find their eastern base to have a direction nearly northwest and southeast, and the range crossing the Missouri at "The Gate of the Mountains." Continuing southeast, it crosses the Yellowstone near where Captain Clark reached that river in 1806, (latitude 46,) just south of which it forms high, snow-covered peaks. This line of mountains is broken through again by the Big Horn river, and the mountains receive the name of Big Horn mountains. The southeast terminus of the Big Horn mountains sinks into the elevated table land prairie, and the range perhaps reappears again as the Laramie mountains. (South of the latitude of Fort Laramie the line of the eastern front of the mountains is nearly north and south.)

The Black Hills, whose geographical position we have determined, are the most eastern portion of what has heretofore been considered a part of the great mountain region west of the Mississippi; and it is worthy of note that, if a line be drawn from them to the Little Rocky mountains, on the 48th parallel, which are the most eastern portion in that latitude, this line will be parallel to the line of the main front of the mountains which I have already traced. What is still more significant is, that if a straight line be drawn from the mouth of the Yellowstone to the mouth of the Kansas river, it will also be parallel to the lines before mentioned, and will have about an equal portion of the Missouri on each side of it.

The line of the east base of the main mountain mass is the highest, of course, of any portion of the plains, and at Raw Hide peak, near Fort Laramie, is about 5,500 feet elevation, as determined by the horizontally stratified tertiary deposits, though owing to great, denudation the average height there of this line of the plains will not be so great

The same line, near the 49th parallel, has probably a somewhat less elevation. The lowest line of the plains is that along the Missouri, and its elevation, taken near Bijou Hills, (a point about on the perpendicular to it from Fort Laramie,) is about 2,130 feet, which does not differ materially from its height at the mouth of the Yellowstone. The slope of all this part of the plains (being in a direction perpendicular to the lines of equal elevation) has therefore its line of greatest descent in a northeast direction, and north of the Niobrara; this is the direction in which a majority of the rivers flow till they join with the Missouri or Yellowstone. To the south of the Niobrara the greatest slope of the plains is to the southeast, towards the Gulf of Mexico, and this is the direction pursued there by nearly all the rivers of the plains. Thus the Niobrara would seem, as it were, to run along a swell or ridge on the surface. The average slope of the plains from the Missouri to the mountains make nowhere an angle greater than one-half degree with the horizon.

A remarkable feature in regard to this change of slope which occurs in the neighborhood of the course of the Niobrara is the shortness of its tributaries, the surface drainage seeming to be away from and not towards its banks. A result of this is the absence of the amphitheatre-like valley which rivers generally have, and which enable us to look down at the stream often many miles distant. Through the greater portion of the middle half of its course you have scarcely any indication of it as you approach, till within close proximity, and then you look down from the steep bluffs, and catch, at the distance of two hundred to five hundred yards, only here and there a glimpse of the river below, so much is it hidden by the precipitous bluffs which at the bends stand at the water-edge. So strongly was I impressed with the fact that the surface drainage could never have been directed along its course so as to have worn out this channel, that I think a portion of it must have originated in a fissure in the rocks which the waters have since enlarged and made more uniform in size, and which the soft nature of the rock would render easy of accomplishment. It is worthy of remark, in this connexion, that the bed of the stream in longitude 102° is four hundred feet higher than that of the White river at the point nearest to this; White river having there cut its way entirely through the tertiary formation, flows along the cretaceous, while the bed of the Niobrara is in the miocene tertiary, the pliocene forming the bluffs. The bed of the Niobrara is also, in two-thirds of its upper course, from three hundred to five hundred feet above the bed of the Platte river at corresponding points at the south.

In the section of the country through which the Niobrara flows the soil is very sandy, so that what rain or snow falls sinks under the surface, and none is lost by evaporation. This is gradually all poured into the stream by the springs in the ravines, and in this way the river is mainly supplied in seasons of low water, at which times it is one of the largest streams of Nebraska.

The question of the slope of the plains is a subject to which I have given much attention, from its scientific as well as practical interest. Our barometric observations have enabled us, in some measure, to fill up the gap between those of Governor Stevens on the north and

Captain Frémont's on the south, and thus give us the connected levels over a very large area.

The observations upon the great tertiary formation have developed the fact, that since the close of the pliocene period the eastern base of the mountains, which is the western limit of this formation, has been elevated from 2,000 to 3,000 feet above the eastern, and this without there being anywhere visible signs of upheaval, such as inclination of the strata. The only direct evidence is in the immense denudation which the tertiary has undergone probably while this elevation was in progress, and which causes of denudation must have been gradually extinguished, as there is, at the present time, no force at work sufficient to have affected them. The evidence goes to show that the elevation which has taken place since the close of the pliocene period has been in Nebraska remarkably uniform, and along a line in a general direction northwest and southeast, and nearly coincident with the ranges of mountains previously upheaved.

The Black Hills received their last violent upheaval at the same period as the Laramie mountains, that is, at the close of the cretaceous. The geological evidence goes to show that the pliocene and miocene tertiary, south of the Shyenne, are fresh water formations; yet there are no ridges now standing to mark the northern boundary to this basin. In the present relative position of the different parts of these plains, the elevation of the pliocene tertiary formation is now so great that much of the Black Hills and the cretaceous on the Shyenne should have been covered with it. This might, however, have been the case, and since have all been denuded away. North of the Shyenne the cretaceous ridges are probably sufficiently high to have separated the tertiary beds south of it from the lignite tertiary to the north. But still it is necessary to suppose that this last elevation of the tertiary has been somewhat greater near the 42d parallel than to the north of it.

A most interesting problem could be solved in regard to these changes of level, if a locality could be found where the lignite tertiary north of the Shyenne would be in contact with the pliocene or miocene beds to the south of it, as well as the more important one of the age of the first relative to the two latter.

During the time of these changes since the formation of the pliocene tertiary, the soft sandy material of which it was composed has been crushed and separated by denuding forces, and an area of no less than 20,000 square miles, called the Sand Hills, has been covered with barren sand, which, blown by the wind into high hills, renders this section not only barren, but in a measure impracticable for travel. The Niobrara river, lying on a most desirable line of communication, and direct in its general course, has 100 miles of its banks obstructed with these difficult hills, and the communication between this stream and the Platte greatly obstructed and in some places entirely cut off. The subject of routes and communications I shall hereafter take up in detail.

For nearly all of the knowledge of the age of the geological formations of the portions of Nebraska developed by my explorations, I am indebted to the services of Dr. F. V. Hayden and Mr. F. B. Meek

and Professor Joseph Leidy, whose papers, published in the Proceedings of the Academy of Natural Sciences, have already made known some of the principal discoveries and results due to their labors. Dr. Hayden was the only one of those mentioned who accompanied me in the field.

In the paper by Dr. Hayden, accompanying the geological map, published in June, 1858, Dr. H. observes that "A much larger surface might have been colored on the map with a good degree of confidence, but I have preferred to confine myself, for the most part, to the results of my own observations in the field." The northeast portion of the boundary of the tertiary formation between the White and Niobrara rivers is there placed too far west, according to my own observations in 1855 and 1857. The line between this and the cretaceous is not west of a straight line between the mouth of the south fork of the White river and the mouth of the Keya Paha. A small portion of tertiary should also be shown on the north side of the south fork of the Shyenne. The great lignite tertiary formation most probably extends almost to the base of the Big Horn mountains.

It is of course impossible to give correctly the relative extent of certain of the formations on a map of this scale. The width of the upheaved sedimentary formations which encircle the igneous rocks of the Black Hills are much more developed on the western than on the eastern slopes, owing to their difference in dip—on the western being quite gentle, but steep on the other, causing them soon to disappear under the cretaceous rocks; and this is one of the most important features in the configuration of these mountains.

From what has been said it will be seen that the surface of Nebraska presents two great sections—that of the plains, and that of the mountains.

The plains in this latitude are composed of nearly horizontal strata of the tertiary and cretaceous formations, except in a small portion of the southeast corner, where the carboniferous is developed. Though the plains are much diversified by the effects of denuding agencies, and present in different portions striking characteristics, yet they are, as a whole, a great uniform surface gradually rising towards the mountains, at the base of which they attain an elevation varying between 3,000 and 5,500 feet above the level of the sea. The plains have three distinct portions as determined by their geological formation: 1st, the pliocene and miocene tertiary; 2d, the cretaceous; and 3d, the lignite tertiary.

The *first section* extends from the southern boundary north, nearly continuous to the 44th parallel, and contains a large portion of the valleys of the Platte, Loup Fork, Niobrara, and White rivers. Here, except in the immediate valleys of the streams, which are composed of good soil, naturally irrigated by springs from the bluffs, or susceptible of irrigation, much of the country is sandy and unfit for cultivation. No valuable mineral or good building stone have been discovered in it. Here are to be found the Sand Hills, which occupy an area north of the Platte of not less than 20,000 square miles. These hills on the north begin between the White and Niobrara rivers, and extend south probably beyond the Arkansas. Where we have visited

them, they vary in height from 10 to 200 feet, and in the western portion are ranged in ridges running east and west; but in travelling you are frequently obliged to cross them, as the intermediate valleys, which are also sand, are not continuous. About the sources of Loup Fork many of the lakes of water found in them are impregnated with salts and unfit to drink, and our sufferings in exploring them will always hold a prominent place in our memories. The present form of these hills is mainly if not entirely due to the wind. Where the grass protects the surface the sand does not drift; but if this is removed, the wind whirls the sand in the air, and often excavates deep holes. I therefore look upon them as utterly impracticable for any line of railroad; for should any attempt be made to grade the surface, which would be necessary, the wind would fill up the cuts with sand as with drifting snow.

In this section is also to be found the Bad Lands, or Mauvaises-Terres, of White river, so celebrated for their vertebrate remains. The locality to which this name (Bad Lands) has been applied is in extent about one hundred and fifty miles long, in a direction northeast and southwest, and about sixty miles wide. The term Bad Lands was given to this section by the traders, on account of the difficulty of getting a road through a portion of it. The extent of the geological formation to which these Bad Lands belong is very great, and, as the name is an improper one to be applied to the whole of it, I shall not use the term except in speaking of the portion occupied by it along the middle course of the White river. In this part of White river some as beautiful valleys are to be found as anywhere in the far west, though, like other parts, the majority of the country is barren. These Bad Lands of the White river country have frequently been spoken of as a vast grave or sepulchre, from the amount of bones found there; and this figure of speech has somewhat tended to give a gloomy idea of the place which it does not especially deserve, as it abounds in the most beautiful and varied forms, in endless variety, giving the most striking and pleasing effects of light and shade. It has also been described as having sunk away from the surrounding world, with the country rising like steps to the Black Hills, which is not the case, many portions of these Bad Lands being higher than all the intervening country between them and the Black Hills, from which the portions on White river are distant about thirty miles. The formation to which this portion belongs extends almost uninterruptedly east to the mouth of the Keya Paha, and south beyond the Platte; and an instance of the striking appearance which it sometimes makes is exhibited in Court-house rock and Scott's bluffs. The word "Bad Lands" is generally applied by the traders to any section of the prairie country where roads are difficult, and in this way to parts of many distinct geological formations; and as it is generally calculated to mislead, should not be used. When I shall use it occasionally, I use only the name of the country, as it was originally given to mean bad land to travel through.

The *second section* is the cretaceous formation, forming the level country at the base of the Black Hills, the valley of the Shyenne river, and the immediate valley of the Missouri river, from Heart river to

the Big Sioux. In this section the soil is clayey; and wherever there is a sufficiency of rain, or streams can be found to irrigate the land, it will be productive. The great drawback to its fertility is a want of timely rains. A portion of this formation, from the Big Bend to the Shynenne, is composed of black shale, and contains much saline matter, which renders the water in places unhealthy, and adds to the sterility of the soil along the bluffs of the streams, where saline springs are common. In this section, too, there are no valuable minerals or good building stone, except that furnished by the boulders.

The *third section, or lignite tertiary*, extends north and west to the British line. The want of rain, which is felt in this area even more than in the one to the south of it, renders it nearly barren. Everywhere, through this formation, beds of lignite are to be found, sometimes of a thickness of six and seven feet. The burnt appearance of earth, along the banks of the streams, shows that in former times these beds have been on fire over large areas, and in places are entirely burned out, and those on Powder river are said to be on fire at this time. There is every reason to believe that in places this lignite will be found of quality good enough for fuel. In this section the boulders furnish the only good building stone.

In nearly all parts of Nebraska good clay for making brick can be found.

The carboniferous formation is developed in a small part of the southeastern portion of the prairie of Nebraska, and I will quote from the report of Dr. Hayden in relation to the coal of this section: "The town of De Soto is the highest point known on the Missouri where these limestones are exposed. Ascending the valley of the Platte river we find them quite well developed as far as the mouth of the Elk Horn, where they pass beneath the bed of the river, and the sandstone No. 1 occupies the country.

"Several small seams of coal have been found in these limestones at Bellevue and other localities, and in the valley of the Platte. About ten miles above its mouth I noticed a bed of very dark carbonaceous shale, two feet in thickness, cropping out near the water's edge. This was considered by the inhabitants as a sufficient proof of the existence of a workable bed of coal in the vicinity. The evidence now points to the conclusion that though these limestones belong to the true coal measures, they hold a position above the workable beds of coal, and that it is not probable a valuable seam of coal will be found north of the southern line of Nebraska. A bed of coal, of inferior quality, has been wrought near Leavenworth City, Kansas Territory, but it holds a lower geological position than the limestones of the southern portion of Nebraska, the dip of the strata being toward the northeast." As our examinations were always somewhat hurried, there is room to expect that workable beds of coal may yet be found here, but at present we know of no facts against the opinion given by Dr. Hayden.

The seam of very inferior lignite found in the neighborhood of Sioux City in the cretaceous rocks may possibly, in some places, furnish fuel of value, but where seen by us as exposed it gives but little promise. In this case, as well as the coal seams in the Platte, mentioned above,

it may be that on penetrating to the interior portions of those beds they will improve in quality.

The section of Nebraska which is now being occupied by settlers has fertile soil, not surpassed by any portion of the prairies of the Mississippi valley. In this eastern section will be found the fertile and wooded valley of the Elk Horn river, and all the wooded parts of the valley of the River Platte. In the southern portion of it good building stone is furnished by the carboniferous rocks.

After passing to the west of the 97th meridian we begin to meet with sandy tracts, especially near the 42d parallel, in which latitude the sand hills extend the furthest east. In my former report I said that but a small portion of Nebraska which I had visited is susceptible of cultivation west of the 97th meridian. I did not mean to imply that good land on these prairies would not be found west of it, for there are fertile tracts as far west as the 99th meridian, in the neighborhood of streams that are valuable, and contain wood enough to support settlements. In stating that the Territory is overspread by powerful tribes of roving savages, and is only adapted to a life such as theirs, I did not mean to imply that white men could not occupy it, but that if they ever did they would have to lead a life similar to that of the Indians, depending mainly for subsistence not upon the buffalo, but their own herds and flocks for support; and this is most emphatically true of the region between the 99th meridian and the base of the mountains.

There is one thing concerning the longitudes of places west of the Missouri river which causes many persons to deceive themselves, and is worthy of mention here. A common idea is that the course of the Missouri is nearly south from Sioux City to Leavenworth City, and that settlers may go as far west of the one place as the other and find fertile lands. But the course of the Missouri between these points is so much to the east that Sioux City is only fifteen miles east of the meridian of Fort Riley, and Fort Randall is as far west as the western limit of the Cross Timbers on the 35th parallel.

Though the western portion of the prairies of Nebraska is not much inferior to that of corresponding meridians in Kansas and northern Texas, there is no disguising the fact that a great portion of it is irreclaimable desert, with only a little wood and cultivable land along the streams.

The reasons for this are, 1st, an insufficiency of timely rains; 2d, over large areas the soil does not possess the proper constituents; 3d, the severity of the long cold winters and short summers; and a 4th might be included in the clouds of grasshoppers that occasionally destroy the useful vegetation. They are nearly the same as the locusts of Egypt, and no one who has not travelled on the prairie and seen for himself can appreciate the magnitude of these insect swarms. Often they fill the air for many miles of extent so that an experienced eye can scarce distinguish their appearance from that of a shower of rain or the smoke of a prairie fire. The height of their flight may be somewhat appreciated, as Mr. E. James saw them above his head as far as their size would render them visible while standing on the top of a peak of the Rocky Mountains, 8,500 feet above the level of the

plains, and an elevation of 14,500 above that of the sea, in the region where the snow lies all the year. To a person standing in one of these swarms as they pass over and around him, the air becomes sensibly darkened, and the sound produced by their wings resembles that of the passage of a train of cars on a railroad when standing two or three hundred yards from the track. The Mormon settlements have suffered more from the ravages of these insects than probably all other causes combined. They destroyed nearly all the vegetables cultivated last year at Fort Randall, and extended their ravages east as far as Iowa.

It must be observed, however, that good grass will generally be found all over these plains, varying in quantity and kind with different localities, and that the desert character of the country is not like that found in the deserts on Green river and Snake river, west of the South Pass, where even a sufficiency for animals cannot be found.

A very different condition of soil, water, and building material of stone and wood, exists when we reach the mountain region.

The Black Hills, or more properly mountains, lying between the forks of the Shyenne, on the 44th parallel, between the 103d and 105th meridians, cover an area of 6,000 square miles. Their bases are elevated from 2,500 feet to 3,500 feet, and the highest peaks are about 6,700 feet above the ocean level.

The different rocks which compose these mountains, as determined by our exploration, are—

- I. Metamorphosed azoic rock, including granite.
- II. Lower silurian, (Potsdam sandstone) .
- III. Devonian?
- IV. Carboniferous.
- V. Permian.
- VI. Jurassic.
- VII. Cretaceous.

All the rocks below the silurian are igneous and metamorphic, and the stratification which they exhibit stands everywhere nearly vertical, with a strike varying between northeast and northwest. So constant is this vertical dip, that it may not in reality indicate primary stratification, but some mechanical arrangement due to the molecular forces brought into existence during its cooling from the heated state. All the rocks, from the silurian to the close of the cretaceous, apparently lie conformable to each other. The shape of the mass is elliptical. The direction of the longest line of this or major axis being about north 20° west. On the west the rocks dip, as a whole, very gently, and at a distance of five miles from the foot of the hills the cretaceous is apparently undisturbed, though at the base these rocks in some places stand at an angle of 45° . The manner in which this rock lies suggests the idea that the cretaceous probably forms a considerable portion of the elevated plateau between the Black Hills and Big Horn mountains. The dip of the upheaved rocks on the west side is as a whole very gentle, not amounting to more than from 5° to 15° , and consequently they are considerably developed, and form more than one-half the mountain mass composing some very high ridges. These rocks have a much greater inclination on the east side of the moun-

tains, and soon disappear under the cretaceous, forming a comparatively narrow belt. The east base of the mountains is from 2,000 to 3,000 feet below the western.

The rocks seem also to dip much more suddenly down on the south than on the north side. The strike of these upheaved strata is in almost every direction corresponding on the exterior nearly with that of the tangent to the outline of the mass, and on the interior being more nearly coincident with the direction of the major axis.

A result of this formation is that the upturned rocks break off abruptly on the side towards the interior of the mass, and leave an open valley in many places between this steep slope and the gentle one which succeeds it as we approach the interior. In these valleys the best roads are found, and one, which nearly encircles the Black Hills, is known among the Indians and traders as the Race Course or Running road.

The Inyan Kara Peak is basaltic, and the appearance through a powerful spy-glass of those to the north, known as the "Bear's Lodge" and "Little Missouri Buttes," indicates that they are also of this formation. More recent volcanic action is visible at Bears' Peak, and two circular spaces to the west of this peak, now occupied by muddy lakes, indicate the existence here in former times of volcanic forces.

The highest mountain masses, such as Harney's Peak, on the east side, are all granite, the rocks, as seen at a distance, appearing in the same unmistakable form as those on the Raw Hide and Laramie Peaks, namely, coarse granite or gneiss, standing in layers and slabs, indicating a vertical stratification. A full description of these mountains must be left for the final report. They derive their name from being covered with pine, whose dark green gives them a black appearance.

In reference to the carboniferous rocks in these mountains, Dr. Hayden says: "The exact positions in the carboniferous system to which the limestones around Fort Laramie and in the Black Hills belong, is not sufficiently clear from the evidence yet obtained. They do not seem to be the equivalents of the beds above described along the Missouri, though they may be. The texture of the rock is quite unlike any of the limestones of the coal measure with which we are acquainted, and there seems to be an absence of the fossils characteristic of the coal measure limestones on the Missouri, and in north-eastern Kansas. The latest opinion, however, of my associate, Mr. Meek, is that they belong to the true coal measures."

In these mountain formations, which border the great plains on the west, are to be found beautiful flowing streams, and small rich valleys covered over with fine grass for hay, and susceptible of cultivation by means of irrigation. Fine timber for fuel and lumber, limestone and good stone for building purposes are here abundant. Gold has been found in places in valuable quantities, and without doubt the more common and useful minerals will be discovered when more minute examinations are made.

I think it exceedingly desirable that something should be done to encourage settlements in the neighborhood of Fort Laramie. The wealth of that country is not properly valued, and the Indian title not being extinguished there is no opportunity to settle it. Those who

live there now support themselves by trade with the Indians, which being already overdone, it is to their interest to keep others away. If the Indian title were extinguished, and the protection of the territorial government extended there, so as to be effectual, there would soon spring up a settlement that would rival that of Great Salt Lake. The Laramie river is a beautiful stream, with a fine fertile valley, and there are such everywhere along the base of the mountains. Pine timber, of the finest quality, in abundance grows there, easy of access, from which the finest lumber can be made; building stone of good quality abounds. The establishment of the military post, and the constant passing of emigrants, have driven away the game, so that the Indians do not set a high value on the land, and it could easily be procured from them.

The people now on the extreme frontiers of Nebraska are near the western limit of the fertile portions of the prairie lands, and a desert space separates them from the fertile and desirable region in the western mountains. They are, as it were, on the shore of a sea, up to which population and agriculture may advance, and no further. But this gives them much of the value of places along the Atlantic frontier, in view of the future settlements to be formed in the mountains, between which and the present frontier a most valuable trade would exist. The western frontier has always been looking to the east for a market, but as soon as the wave of emigration has passed over the desert portion of the plains, to which the discoveries of gold have already given an impetus that will propel it to the fertile valleys of the Rocky mountains, then will the present frontier of Kansas and Nebraska become the starting point for all the products of the Mississippi valley which the population of the mountains will require. We see the effects of it in the benefits which the western frontier of Missouri has received from the Santa Fé trade, and still more plainly in the impetus given to Leavenworth by the operations of the army of Utah in the interior region. This flow of products has, in the last instance, been only in one direction, but when those mountains become settled, as they eventually must, then there will be a reciprocal trade materially beneficial to both.

These settlements in the mountains cannot be agricultural to the same extent as those on the Mississippi valley, but must depend greatly upon the raising of stock. The country furnishes the means of raising sufficient quantities of grain and vegetables for the use of the inhabitants, and beautiful, healthy, and desirable locations for their homes. The remarkable freedom here from sickness is one of the attractive features of the region, and will, in this respect, go far to recompense the settler from the Mississippi valley for his loss in the smaller amount of products that can be taken from the soil. The great want of suitable building material which now so seriously retards the growth of the west will not be felt there.

How far the fine timbers in the interior of Nebraska can be relied upon to supply settlements on the Missouri is a question upon which I am not qualified to give a very positive opinion.

The pine extends along the Niobrara and its side ravines for about 120 miles, and there is nearly an equal extent of it on White river; but on

both streams it is of inferior quality and difficult of access. That at the Black Hills is much better timber, and covers an area of about 1500 square miles; but this is also in situations where there would be much labor in getting it out, and an Indian war would probably attend the first attempts to do so. I think the Niobrara, White, and Shyenne rivers could be used to bring the logs to the Missouri, down which they could be rafted.

The great want of timber which is felt along the settlements on the Missouri, and the high price which this material commands, may probably overcome all the difficulties I have stated to exist; and, having done this as faithfully as I can, I must leave each one to form his own opinion on the subject.

CHAPTER III.

Remarks on the climate—meteorology.

The seasons I have spent in Nebraska have, as I am informed by those who have resided there a long time, been favored with an unusual supply of rain. With this caution as to the inferences which may be drawn from our observations, I will give a short account of some of the meteorological phenomena observed by us.

In the year 1855 we left Fort Leavenworth on the 15th of June, and reached Fort Pierre on the 16th of July. During the passage up the river we had 13 days of nearly calm weather; 10 days of south or southeast wind, sometimes very strong; seven thunder-storms, some of them of great violence, with much rain, the amount diminishing as we ascended the river, (there being no heavy rain after the 29th of June, all of which time we were above the mouth of the Niobrara.) The highest temperature observed was on July 15, at 2 p. m., at which time the dry thermometer gave 102° in the shade, and the wet bulb thermometer 69°. When we reached Fort Pierre we were informed that there had been no rain or snow there for more than a year. The appearance of the vegetation confirmed this statement, as scarcely a green spot was anywhere to be seen.

Hourly observations on the wet and dry bulb thermometers and barometers were made at Fort Pierre from July 17 to 25, and at the hours of 7 a. m., 9 and 2 p. m., till August 7. The mean height of the barometric column at this place is (reduced to 32°) 28.436; the altitude above the sea, 1,500 feet. The highest temperature observed during this time was, at 3 p. m., July 22, dry thermometer, 86°; wet bulb thermometer, 64°; the barometer, reduced to 32°, reading 28.310. On the same evening we had a heavy fall of rain, with thunder and lightning, about 5 miles south of the fort; this was the first rain experienced in the neighborhood. From July 22 to August 7 there were three violent thunder-storms from the west, one of which was attended with a heavy fall of rain. An abundance of rain continued to fall here during the summer.

While on the journey from Fort Pierre to Fort Kearney, between

August 7 and August 22, we had much overcast and misty weather nearly all the time, and on seven of the days rain fell in small quantities.

From August 25 to September 12 we were on the road along the Platte river between Fort Kearney and Fort Laramie; during this time we had two heavy thunder storms, attended with a large fall of rain. While at Fort Laramie, we had heavy frost about the 25th of September. Fort Laramie has an elevation of 4,200 feet.

From September 29 to October 19 we were on the road to Fort Pierre. The weather at times was very cold, and snow fell to the depth of four inches on the night of the 3d of October; for several days in the first part of this month the thermometer stood, at day-break, at 29° . On the 20th and 21st of October we had a violent storm of rain, sleet, and snow, with high winds, which covered everything with ice. We were quite surprised, on reaching the neighborhood of Fort Pierre, to find the grass green and abundant, for it was such a contrast to its appearance in August, when everything seemed to have perished for want of rain. Much snow fell here during the winter, and in the spring there were heavy showers of rain, so that a more beautiful prairie country could not be found than this, as it appeared in May and June, 1856. At the same time the previous year the grasses scarce gave an indication of life.

We left Fort Pierre on the 28th of June, 1856, and reached Fort Union on the 10th of July; on the passage the weather was comparatively clear, with light winds. Up to this time no rain had fallen there, and in many places there was a great scarcity of grass. On the 15th a heavy storm of rain and wind commenced at 9 p. m., and continued till 10 p. m. on the 17th. The wind for several days previous had been light, and came from the north. On the 15th, at 2 p. m., the thermometer was at 90° , the barometer (reduced to 32°) reading 27.827. At 9 a. m., on the 16th, the barometer read 27.735; thermometer 58° . The wind blew with great violence from the north all day on the 16th, so that it was with great difficulty we kept our tents standing; and a portion of the enclosure of the American Fur Company's fort was blown down. This storm was not accompanied by thunder and lightning. On the 17th the weather was again clear; wind light from the northeast; thermometer, at 2 p. m., 67° ; barometer, 28.179. Fort Union has an elevation of 1,900 feet above the sea.

While at Fort Union and in the neighborhood we had after this abundance of rain, so that the whole landscape in August and September wore a beautiful green, and grass was plenty in places where, in July, there was not a blade of it. The highest temperature we experienced here was on the 20th of July, the thermometer, at 2 p. m., reading 93° . The earliest frost ever recorded to have occurred here was in the month of August of 1855.

We left Fort Union the first of September and reached Fort Pierre on the fifth of October. We were again struck with the variable nature of the climate on finding that but little rain had fallen here during our absence and the grass had all dried up, though at this place the same period of the previous year it was everywhere green.

In the year of 1857 we started from Omaha the 28th of June, in the midst of the rainy season, and reached Fort Laramie August 20. During this journey we had fifteen rainy days, or about in one four, and on many other days there were showers with thunder and lightning near us that are not included. The highest temperature was 100° , 2 p. m., August 11.

Prior to our arrival at Fort Laramie not much rain had fallen there; but on the 22d it commenced, at 11 a. m., to rain hard and continued, with but little intermission, till the 24th. This storm was not accompanied by violent wind, and the barometer gave very little indication of its approach, preserving about a reading of 25.980. No one there remembered to have ever seen so much rain fall at one time at that place.

I left Fort Laramie on the 4th of September; we had one heavy rain on the 10th, at the base of the Black Hills. While in the Black Hills we had a storm that lasted from 6 a. m. on the 16th till 9 p. m. on the 17th. As we were travelling and changed our altitude during this storm, and while it was coming on, the indications of the barometer are not of any value. Our elevation was about 5,500 feet. The storm began with a cold rain, thermometer 54° . The temperature gradually fell till the rain changed to snow during the night of the 16th, and the thermometer went down to 32° . There was a strong wind a portion of the time from the north. During the latter part of this storm we were enveloped in the clouds, and as it cleared up these gradually rose, as we could see by the line they made along the sides of the high peaks and ridges.

We experienced a very violent storm, of about twenty-four hours' duration, on the 8th of October, while on White river, and had a fall of about six inches of snow on the Niobrara on the 18th of October. From the 18th of October to the 31st we had four storms of rain and sleet.

I have not attempted here to give the direction of the wind during the period, as it could only be done satisfactorily by copying the daily register. The prevailing wind through the year is from the north, as is fully established by the sand hills along the Niobrara. The wind has blown these up to the brink of the precipices along the north bank, and on the south has removed them to the distance of about half a mile. October is generally a very windy month. In 1856, fifteen days of this month, while we were travelling down the Missouri in a Mackinac boat, from Fort Pierre to Sioux City, it blew so we could not proceed. The prevailing wind at this time was from the south, and we had one violent rain storm, with a south wind.

A true indication of the nature of the climate of Nebraska is to be found in the character of the plants which grow there. Certain kinds, unable to live through the long periods of drought which occur, are rarely to be seen, and those which flourish best are such as require but little moisture, or whose roots, penetrating deep into the soil, enable them to draw a sufficiency of moisture from below. In the high prairies, where there is a good soil, we find the bunch grass growing in tufts, but in many places interspersed with patches of cacti. The bottom lands of many of the streams support no trees but

the cottonwood and willow, and some of them produce rank growths of the wild sage.

The absence of trees on all the prairie regions is another evidence of the dryness of the climate, and even in places where they can grow, as in the ravines, the excessive cold of the winter winds prevent them from reaching their full development, as is proved by the dead tops of nearly all the trees which extend their branches above the level of the prairie. The prairie fires have done much towards preventing the growth of trees in places adapted to them, but it is not a sufficient cause to account for the general absence of forests.

An interesting instance of the effect of climate on the growth of trees is to be seen in the cedar as you ascend the Missouri. At the first Cedar island, in latitude 43, these trees grow in the bottom lands of the river, and are large and straight, those growing on the bluffs being of an inferior quality.

The cedars diminish as you ascend, and the last of these in any number together is to be seen in the bluffs opposite the mouth of the Little Shyenne, in about latitude 45, and here they are exceedingly crooked and twisted. Along the Missouri and Yellowstone, in the lignite tertiary formation, we find the cedar unable to support itself above the ground, and, spreading itself over the surface, presents the appearance on the hill sides of grass or moss.

During the time I have been in Nebraska I have found everywhere an abundance of grass, except in places near the posts and others, where it had been eaten off by the buffalo.

A considerable quantity of a small variety of corn is raised by the Mandans, Rees, and Gros Ventres, near the 47th parallel, on the Missouri, and it is probable that this corn can be raised along the base of mountains as far north as the 46th parallel. The entire mountain section of Nebraska will produce good wheat, where the land can be irrigated, and the abundance of grass for pasturage will permit of the raising of immense herds of stock.

This western portion of Nebraska may, therefore, in the future be valuable for occupation for a people partly engaged in agriculture, but relying mainly upon the raising of stock.

Many valuable inferences in regard to the climate may be drawn from an examination of the catalogue of plants growing in Nebraska, prepared by Dr. Hayden, and appended to this report.

It is my intention to give tables of the meteorological observations in a subsequent report. These, besides the indication they afford of the climate of Nebraska, will be useful in aiding the determinations of the progress and limits of storms over large areas in connexion with extensive investigations on this subject carried on by the Smithsonian Institution, under the direction of Professor Henry.

The thunder storms, so far as we have observed them, have a great uniformity. The day after one has passed over is generally cold, with a light north wind and high state of the barometer. This condition lasts from one to three days, when the wind changes to the south and gradually increases in force during the day, and sometimes falling almost to a calm at night. The barometer falls during the time, and cumulus clouds begin to form. After the south wind has blown three

or four days, a thunder storm comes from the west, generally in the night; the south wind often blowing a hurricane all the time the storm is approaching from the west. This storm is again succeeded by cool weather and a high state of the barometer, and in general we found a sure indication of the approach or termination of a storm in the falling or rising of the barometric column. These storms as seen on the prairie have a number of independent centres, so that they often pass across the landscape to the north and south without your receiving any of the rain. They are frequently accompanied by a fall of hail and violent gusts of wind.

CHAPTER IV.

Description of principal rivers and discussion of the merits of different routes.

In giving a description of the character and importance of the rivers examined, it will perhaps be best to discuss at the same time the subject of routes, as they are intimately connected.

The Missouri, therefore, claims our first attention, and though it has been so repeatedly described by others, a few of its general features may be enumerated here. A detailed account of the various points we examined as locations for military posts must be reserved for the final report. This great stream has generally a uniform width from the junction with the Yellowstone to its mouth, varying from $\frac{1}{3}$ to $\frac{1}{2}$ a mile when the banks are full. In low water the width is much less and dry bars of sand occupy portions of the bed, from which the water has withdrawn. In the upper part of the river where the trees do not destroy the force of the wind, the sand is blown about in the most astonishing manner, and the clouds of sand can be seen for many miles. Sand banks are thus formed, generally at the edges of the trees on the islands and points, and which are often many feet above the level of the highest floods.

The force of these winds may be inferred from this, and from their constancy during certain months, especially in October, are of themselves one of the greatest obstacles to the navigation of the river.

The plans which these sand banks exhibit are those of the perimeters of the islands and points on which they were formed, and not unlike those of the Indian mounds in the Mississippi valley, which are supposed to be the remains of ancient fortifications. These banks along the Missouri have, therefore, been considered as the works of the aborigines, such, for instance, as those described and figured by Lewis and Clark, as existing at Bon Homme island. I have conclusive evidence, from personal examination, that these were formed by the wind, and are not the work of the ancient Toltecs as some writers have supposed.

The river has generally, in the same stages of the floods, about as good navigation on account of the depth above James river as it has

at that point, but an improvement takes place below this point, in the depth of the water on the sand bars in low stages, as you descend to its mouth.

Along the banks of the Missouri the bluffs are generally clothed with various species of trees as far up as the mouth of the Platte; above this point the timber is generally confined to the ravines and bottom lands. These bottom lands attain a width of from ten to fifteen miles after we get above Council Bluffs, which is almost continuous to the mouth of James river. Throughout this section the edges of the banks are lined with heavy cottonwood and other trees, and fuel for steamboats can now generally be found cut up and prepared for their use.

At James river the bluffs close in so that the general width of the space between is only from one to two miles all the way to the Upper Big Bend, near the 48th parallel. Here again the bottom lands become wider, and continue at a width of from three to six miles to a point about fifty miles above the Yellowstone. In this last section there is also an abundance of large cottonwood timber, and the appearance of the river is quite similar to what it is at Sioux City. After passing the Niobrara the steamboat's crew will have to cut the wood required for generating steam, and the only scarcity will be in finding dead trees at such points as the boat can land at. Abundance of fuel exists everywhere, if the wood was cut beforehand and hauled to suitable landings. The portion of the river most deficient in wood is between the mouth of the Little Shyenne and Cannon Ball rivers, but even here there is an abundance for the purposes of navigation for years to come.

One of the greatest obstructions to the navigation of the Missouri consists in the great number of snags or trees, whose roots, imbedded in the channel by the caving of the banks, stand at various inclinations pointing down the stream. These obstructions are, comparatively, quite rare above the mouth of James river, but from this point down to the Mississippi it is a wonder often how a steamboat can be navigated through them. As it is they cause the boats to lie by during the night, and thus occasion a loss of nearly half of their running time. But this is not the only delay, for often on account of the wind the bends filled with snags cannot be passed, and the vessel is frequently detained for days on this account. This effect of the wind is much more seriously felt as you ascend above Council Bluffs, for the protection afforded by the trees on the banks is constantly diminishing.

Our examinations extended but sixty miles above the mouth of the Yellowstone, but the portion between this and Fort Benton was examined carefully by the parties under Governor Stevens in 1853, and the results are given in his report on the Pacific railroad explorations. It is the almost universal opinion of those who have examined this portion of the river that it would be navigable in its best stages for light draught boats. From our reconnaissance in 1856, I feel convinced that, notwithstanding the difficulties to navigation which exist, the Missouri is a superior river to any in this country, except that portion of the Mississippi which is below their junction. The navigation is generally closed by ice at Sioux City by the 10th of November, and at Fort Leavenworth

by the 1st of December. The rainy season of the spring and summer commences in different years between the 15th of May and the 30th of June (in the latitude of Kansas, Missouri, Iowa, and southern Nebraska) and lasts about two months. During this period the tributaries of the Missouri in these latitudes maintain this river in good boating stage. The floods produced by the melting snows in the mountains come from the Platte, the Big Shyenne, the Yellowstone, and the Missouri above the Yellowstone, and reach the lower river about the first part of July, and it is mainly to these that the navigator of the Missouri above the Niobrara depends. The length of time the flood lasts is in proportion to the quantity of snow in the mountains, which varies greatly in different years. On the average it may be said to last a month, but a steamer starting from St. Louis on the first indication there of such rise would not generally reach the Yellowstone before it was nearly past this latter point. Rivers like this, whose navigation depends upon the temporary floods, are greatly inferior for ascending than descending boats. The rise at the Yellowstone would be about ten days reaching St. Louis, and any good system of telegraphing along the stream, which would apprise those below, would more than double the advantages to the upward navigation. If a miscalculation is made by taking a temporary rise for the main one, the boat has to lay by in the middle part of the river till the main rise comes. From this cause I, starting on the 16th of April, was thirty-seven days in getting to Fort Pierre, 1,250 miles from St. Louis. Again, if the boat starts too late the main rise may all pass the upper river before she reaches it, and her progress will then be slow and tedious. By starting June 6, 1855, (which was too late, it being an early season,) we were forty-one days going to Fort Pierre.

The American Fur Company's boats are of the largest class of freight boats now navigating the Missouri. They are ably managed, and the company possesses information by expresses sent from its trading posts near the mountains as to the amount of snow that has fallen and the probable extent and time of the rise produced by its melting. The boats are loaded and time of starting fixed accordingly. Their boats carry from one hundred and fifty to two hundred tons to the Yellowstone, a distance of 1,900 miles, drawing from three to three and a half feet of water, and make the passage up in from twenty-two to thirty-five days. Considerable freight is taken out for the post of Fort Union, and they generally ascend with that for Fort Benton to about sixty miles above the mouth of the Yellowstone, and have on one occasion gone to Milk river, one hundred miles further.

The quantity of water is, on the average, about equal from the Yellowstone and Missouri at their junction, and above this point steamboats venture with caution. The great risk in proceeding further of having the boat caught in the upper river during the winter more than counterbalances the prospective gain. The freight is then taken on board of Mackinac boats, and cordeled by hand, aided generally by sails. These boats are from sixty to seventy feet long, drawing fifteen to eighteen inches, (regulated somewhat by the cordeling force,) though twenty to twenty-four inches draught could

be used. The time from Fort Union to Fort Benton varies from forty to eighty days, depending on various causes, of which wind is the most important. The river distance from Milk river to Fort Benton is about five hundred miles.

The interests of the general government would be much advanced by making appropriations to remove the snags which obstruct the river below James river.

The Yellowstone.—For the first one hundred miles above the mouth the bottom lands are nearly all on the left bank; and the first forty miles are from four to five miles broad, with beautiful, soft, rounded bluffs to the west; the banks of the river are clothed with large cotton-wood trees, and the country presents one of the finest locations for a military post and Indian reservation anywhere to be found. After you advance about forty miles up the left bank, the bluffs begin to come on this side almost to the river, and the bottom lands narrow and the timber diminishes. A good route for wagons, however, exists on this side for one hundred miles above the mouth. Having gone thus far you meet with very impracticable bluffs, barely permitting of the passage of pack mules, to get around which with wagons, without crossing the Yellowstone, you must travel out into the prairie one or two days' journey, so as to head the difficult ravines. Bluffs similar to these exist on the right bank all the way from the mouth to this place, but here the river suddenly changes its position in the valley, so as to leave the open valley on the right bank, and causes the difficulty which exists on the other.

This point is also the highest point navigable for steamboats, and those even of very light draught cannot, except at high water, go further than about fifty miles from the mouth, as, in the next space of fifty miles, the channel is so very much divided up by wooded islands and obstructed by gravel bars. But at the point before mentioned as the head of steamboat navigation, ledges of rock begin in the bed of the stream, and about one-half mile below Powder river we encounter a dangerous rapid, called by Captain Clarke "Wolf rapid." Two miles above Powder river Captain Clarke describes another serious rapid, which he calls "Bear rapid;" and twenty miles above this another, which he calls "Buffalo shoal," and which he speaks of as being "the most difficult part of the Yellowstone river." All these rapids are passed every year by the Mackinac boats of the American Fur Company on their way to Fort Alexander Sarpie, and there are probably no obstacles sufficient to prevent them from reaching the point where this river debouches from the mountains.

The valley, all the way to the mountains, is said to be practicable for wagons. Above this point the river is said to be much enclosed by the mountains, which are rugged and difficult, and covered with pine forests.

From Fort Union to Fort Alexander Sarpie, on the Yellowstone, the Mackinac boats are from 50 to 60 feet long, drawing from 15 to 20 inches water, and make the distance, 225 miles, in from 15 to 30 days.

None of the tributaries of the Yellowstone, (Clark's Fork, Big Horn,

Tongue, and Powder rivers,) above their mouths, have ever been visited by any exploring expedition, except those of trappers and hunters.

The Big Horn river is by far the most important of those streams, and has been navigated by the traders in skin boats, carrying their peltries, from the point where it debouches from the Big Horn mountains to the Yellowstone, a distance of perhaps 150 miles. Above where the stream escapes the mountains it is not navigable for anything but the smallest boats, and the gorges by which the stream passes the mountain range is impracticable for any kind of land transportation; a considerable detour being required even for pack animals. The portion navigable will, perhaps, according to the opinion of Colonel Robert Campbell, of St. Louis, furnish a depth of water for Mackinac boats, in high stages, of about 18 inches, but he thinks the navigation of this stream for ascending boats could not be used to any advantage. An undue importance has been given to the navigability of this stream from the erroneous position of the Yellowstone, as laid down on nearly all recent maps, except those from this office, as they make its position nearly 100 miles too far south. The manner in which I have been able to correct this is given in my report on the compilation of the general Pacific railroad map.

Powder river.—This stream rises near the southern point of the Big Horn mountains, and flows a little east of north. The route from the Platte to the Yellowstone along the stream is practicable, but as a route for wagons it is difficult, requiring the stream to be frequently crossed, and the banks are very muddy, and the bed is occupied in places by quick sand.

The Little Missouri river rises near the North Fork of the Shyenne in longitude 105° . I have seen the country near its source, where it forms the northern part of the upheaved stratified rocks of the Black Hills, and at the mouth where the lignite tertiary exists. Its general direction is northeast, and its course through the main portion must be in this lignite tertiary formation. From the statements of members of Sir George Gore's party, which travelled up the stream in 1856, I infer that the route along or near its valley is practicable for wagons, though difficult. The valley is one of the great buffalo regions.

The Knife river, Heart river, Cannon Ball river, Grand river, and Moreau river, all rise in the prairie ridge east of the Little Missouri, and they contain but little water in the winter and latter part of summer. I have never seen any of them, except at their mouths, and their lengths on my map indicate their comparative size.

The Big Shyenne is a most important river, and has its extreme sources west of the Black Hills, which its two main branches enclose. These forks are supplied by numerous streams from the mountains, and they unite in about longitude $102^{\circ} 20'$, the river flowing into the Missouri in latitude $44^{\circ} 48'$. In its lower course I am informed there is fertile land on its banks, and there are considerable areas in and around the Black Hills. The Shyenne river can probably be rafted, and the streams that come from the hills could be used to drive the logs down to the river. It must be borne in mind that the pine growing on the Black Hills is difficult of access, and the expense of getting

it out may render this fine supply of timber unavailable to the lower Missouri. The Missouri at the mouth of the Shyenne is in the centre of the Dakota country, and along its valley we have the shortest and best route by which to reach their strongholds.

Bad river, Wakpa Spicha, (sometimes called Teton river,) receives its name from the unpalatable state of its water in low stages, and the difficulty of travelling along it in wet weather. It lies throughout in the black shale bed of the cretaceous formation. It is along the sources of its northern branches that the road from Fort Pierre to Fort Laramie is located.

White river, or White-earth river, (Mankisita Wakpa, or Smoking-earth river,) has generally an open, well-wooded valley, with a fine soil and luxuriant grass. The road between Forts Laramie and Pierre follows the valley from its source to the Bad Lands, where the river enters a difficult section bounded with precipices like those on the Niobrara. The Bad Lands extend continuously down the stream to the South Fork, a distance of about seventy miles. Below this, the river winds through a handsome, well-wooded valley of the Missouri. Any one who travels in Nebraska will always feel rejoiced when he reaches the banks of this beautiful stream. It is much resorted to by the Brulés. It has numerous branches, the largest of which is called the South Fork. The pine on White river and its tributaries is nearly equal in extent to that on the Niobrara. This stream has been used by the traders to float down their peltries by means of skin boats from their former trading-house near Butte Caché. I believe it can also be used to raft down the pine timber on the South Fork.

The Niobrara being a stream heretofore unknown, and one in which the people of Nebraska feel much interest, I shall describe it in detail. This river is about three hundred and fifty miles long. From its source to longitude $103^{\circ} 15'$ it is a beautiful little stream of clear running water, of a width of from ten to fifteen feet, gradually widening as it descends. Its valley furnishes here very good grass, abounding in rushes or prele, but is for the most part destitute of wood even for cooking. After flowing thus far it rapidly widens, till in longitude $102^{\circ} 30'$ it attains a width of sixty to eighty yards; its valley is still quite open and easy to travel along, but destitute of wood, except occasional pines on the distant hills to the north. In longitude $102^{\circ} 30'$ it enters between high steep banks which closely confine it, and for a long way it is a complete cañon; here, however, wood becomes more abundant and pine is occasionally seen on the bluffs, while small clusters of cottonwood, elm, and ash occupy the narrow points left by its windings. In longitude $101^{\circ} 45'$ the sand hills come on the north side close to the river, while on the south side they are at the distance of from one to two miles off, leaving a smooth road to travel on along the bluffs. The bluffs gradually appear higher and higher above the stream as it descends until they reach the height of three hundred feet. The sand mostly ceases on the north side in longitude $100^{\circ} 23'$; but it lies close to the stream on the south side nearly all the way to the Wazi-honska. Throughout this section, lying between longitude $102^{\circ} 00'$ and longitude $99^{\circ} 20'$, a distance of one hun-

dred and eighty miles, the Niobrara is in every respect a peculiar stream, and there is none that I know of that it can be compared with. It flows here between high rocky banks of soft white and yellowish calcareous and silicious sandstone, standing often in precipices at the water's edge, its verticality being preserved by a capping of hard grit. It is here impossible to travel any considerable distance along its immediate banks without having frequently to climb the ridges which rise sometimes perpendicularly from the stream. As you approach from the north or south there are no indications of a river till you come within two or three miles of the banks, and then only by the trees whose tops occasionally rise above the ravines in which they grow, so completely is it walled in by the high bluffs which enclose its narrow valley. It seems as if it had resulted from a fissure in the earth's crust, and now flows at a depth of about three hundred feet below the general level of the prairie. The soft rock which forms the bluffs is worn into the most intricate labyrinths by the little streams, all of which have their sources in beautiful gushing springs of clear cold water. In these small deep valleys the grass is luxuriant; pine, ash, and oak are abundant. To the agriculturist this section has, however, comparatively little attraction, and that between longitude $99^{\circ} 20'$ and the mouth, an extent of about ninety miles, is perhaps far more valuable. Here the bottoms will probably average a width of a quarter of a mile, are susceptible of cultivation, and cottonwood, oak, walnut, and ash will furnish settlements with all the timber and fuel they will need. The river banks seem to present no good building stone, nor did we, though searching diligently, discover any signs of coal or other valuable minerals.

In describing the tributaries to the Niobrara, I shall begin at the mouth and take the north side first. The Ponka river, which has a very fine, well-wooded, and fertile valley, runs into the Missouri about five miles north of the Niobrara, in latitude $42^{\circ} 48'$ north. Its course is parallel and near to that of the Niobrara as far up as the mouth of Turtle Hill river.

Turtle Hill river (Keya Paha Wakpa) is the main branch of the Niobrara, and is about one hundred and twenty miles long. Prior to the publication of my report and map of reconnaissances in 1855 this branch was represented erroneously as being equal to the main river, in size, above their junction.

I crossed it in 1855, 60 miles below its mouth, and it has a very fine valley one-half to three-quarters of a mile wide, with good soil and a limited quantity of cottonwood timber. The bed of the stream is sandy, and its waters are clear and sweet; width at the mouth fifty yards. The first 20 miles of the space between this branch and the main river is occupied by sand hills.

The next northern branch which joins the Niobrara, in longitude $100^{\circ} 23'$, is named Mini-cha-duza-Wakpa, or Rapid creek. At its mouth it is about eight yards wide, with a valley about a quarter to half a mile wide, and a soil quite fertile, the banks are scantily fringed with small trees. It forms about the eastern border of the sand hills on the north side of the Niobrara, as far as we could see. Its length is about 50 miles.

There are numerous ravines with steep rocky banks, containing springs and running streams, extending out from five to seven miles between this branch and the Keya Paha, at the heads of which occasionally good camping places may be found.

The mouth of the next stream is in longitude $101^{\circ} 18'$; it has scarcely any appreciable valley, flows between high rocky bluffs difficult to ascend and descend; it is about five yards wide, with clear, deep, swift-running water, and is probably about 35 miles long.

The mouth of the next northern tributary is in longitude $101^{\circ} 30'$, and is called White Earth creek; it is about three-fourths the size of Rapid creek, which it resembles in every particular, and is about 25 miles long. The next, in longitude 102° , is a small spring rivulet about 26 miles long, and above this the branches are all small runs coming from the bluffs, generally dry except after rains, with scarcely any valleys to speak of.

On the south side of the Niobrara there are numerous small branches coming in between its junction with the Missouri and the point where it receives the waters of the Turtle Hill river. Three of these are of considerable size, probably 35 miles long, the bluffs along nearly all of them being more or less covered with scattered pine, and their valleys occupied with clumps of cottonwood, oak, ash, &c. The position of the Elk Horn river, about 30 miles south of the Niobrara, prevents any of these southern branches having a length greater than I have stated. From the mouth of Turtle Hill river to that of the Wazi-honska there are still a greater number of short southern branches, all containing springs of water, and abounding in pine and beautiful oak groves.

Wazi-honska means, in the Dakota language, "the place where the pine extends far out;" and this stream, whose mouth is in longitude 100° , is probably 40 miles long, and all its bluffs and side ravines are green with pine. Its valley, though not so wide, is very similar to that of the Niobrara in this part, which has been described.

Snake river, whose mouth is in longitude $100^{\circ} 45'$, is quite a large stream, some 30 yards wide, its bluffs covered with pine, with a narrow valley like the Wazi-honska.

Above this there is scarcely any branch coming in from the south deserving mention.

Niobrara is a very shallow and "swift flowing stream," as the Canadians say "l'Eau qui Court," abounding in rapids in two-thirds of its upper course, and in its middle portion filled with small islands. In the lower portion its width exceeds that of the Missouri river, and is spread out over sand bars. The bed in the broad portions is quicksand and difficult to ford. Its waters rapidly increase in volume through its middle portion, from the multitude of springs and streamlets that constantly flow into it from the foot of the bluffs and out of the ravines.

The traders of the American Fur Company have navigated it with skin boats, carrying peltries from their former trading house near Snake river, and the stream might permit of rafting if the timber should be found of quality and quantity, and accessibility to defray the expenses. I cannot, however, look upon it as capable of furnish

ing timber for the country on the Missouri, for the reason that much of the pine is too small, crooked, and knotty, and grows in places difficult to transport it from. The species is what is called the Rocky mountain pine, has a yellowish-white appearance, and abounds in resin. The distance on the Niobrara over which these pine ravines extend is about 120 miles.

A road could not be made on the bottom lands of the Niobrara ; it must keep out on the high prairie so as to head the ravines. From the mouth to Turtle Hill river it would take the narrow divide between the Niobrara and Ponka rivers. It should remain on the north side of Turtle Hill river from 20 to 30 miles further, and then cross that stream, as it would thus avoid the sand at the junction of the Niobrara and Turtle Hill rivers, and cross the latter where there is a better ford or narrower stream to bridge. Turning then towards the Niobrara, this river must be crossed in longitude $101^{\circ} 20'$ to avoid the sand hills, and the route must continue on the south side to about longitude 102° , when it should again cross to the north side. These crossings for a wagon road could easily be made at a ford or by bridging, but a proper bridge for a railroad crossing at these places would be a stupendous undertaking ; for, on account of the nature of the banks and ravines, good approaches could not be found so as to descend to the level of the stream, and the bridge would have to be built very high. From longitude 102° west there are no difficulties beyond a scarcity of wood in reaching Fort Laramie, or continuing direct to the South Pass, and in this course abundance of excellent pine would be found near Rawhide Peak.

A preferable road might be found by continuing up Turtle Hill river to its source, and then along the divide between Niobrara and White rivers, striking the former stream in longitude 102° ; but these divides are generally bad for wagon routes, on account of scarcity of water, and it is not certain that we would by that route avoid the sand hills.

I consider the north side of the Niobrara superior to the other for a road for the first 90 miles above the mouth, as the greater number of streams coming in at the south side would occasion considerable detours in gaining good crossing places and approaches. The portion of the river flowing through the sand hill region has the sand on the south side generally for one-half a mile blown away by the wind, leaving a smooth route. On the north side these hills are crowning the very edges of the precipices that rise from the river, and cannot be avoided. The evidence that this difference between the two sides was due to the wind is very complete, and shows that the prevailing winds blow much more from the north here than from the south.

The Elk Horn river rises in about longitude 99° , about 25 miles south of the Niobrara river. Its general course is southeast, and it empties into the Platte. As far up as I have seen it, which is in latitude 42° , it has a broad, fertile, and well wooded valley. Where crossed by Lieutenant Smith in 1855, nearly south from Fort Randall, it is described by him as "a beautiful creek of clear water, with well timbered banks and firm sandy bottom."

The valley of the Loup fork is broad, fertile, and well wooded up as

far as the old Pawnee villages, a distance of about 80 miles. Above this the valley begins to grow sandy and wood more scarce, and about the meridian of 100° becomes worthless. An occasional farm site could, however, be found almost to its head. Near its source it flows through high rocky precipices similar to those on the Niobrara; but its source is in the open and desolate sand hills, a miserable region, impassable for ordinary wagon trains, and by all means to be avoided. The same remark is true of its main north branch and of Calamus river, and probably of the south branch.

The Platte river is the most important tributary of the Missouri in the region under consideration, and its broad and grass-covered valley, leading to the west, furnishes one of the best wagon roads of its length in America. From its mouth to the forks the bluffs are from two to five miles from the water, making an intermediate bottom valley of from four to eight miles wide. From the forks to Fort Laramie the bluffs occasionally come down to the water's edge, and the road has to cross the points of the ridges. From Ash Hollow to Fort Laramie the road is sometimes heavy with sand. Fine cottonwood grows along the banks and on the islands, from the mouth to Fort Kearny; from here up it is scarce and of small size. Cedar is found in the ravines of the bluffs in the neighborhood of the forks and above. The river is about a mile wide and flows over a sandy bottom. When the banks are full it is about six feet deep throughout, having a remarkably level bed; but it is of no use for navigation, as the bed is so broad that the water seldom attains sufficient depth, and then the rise is of short duration.

The streams of the prairies of Nebraska, below the Yellowstone, flowing into the Missouri river, are none of them navigable to any reliable extent, and as most of them run from west to east their greatest practical value is in affording the land route of communication between our present western settlements and those to be formed in the mountains. Their valleys furnish us the only routes by which to traverse the intervening desert, for here only are such supplies of water to be found as are required, and here, too, is the only soil that can be cultivated, and such scanty supplies of wood as the region produces.

Of all the valleys of rivers running into the Missouri that of the Platte furnishes the best route for any kind of a road leading to the interior, and the best point of starting is the vicinity of Omaha City. An appropriation of \$50,000 has been expended on bridges, &c., on the eastern portion of it, and the only important improvement remaining to make it far superior to any route on the south side of the Platte is the establishment of a good crossing of Loup Fork, either by bridge or ferry, both of which are difficult; the first on account of the width of the stream—1,000 yards—and the latter on account of the shoals and shifting sand bars. The ford is bad, by reason of quicksands. Twenty-five thousand dollars would probably make a good crossing to this stream, as the place is within the limit of the settlements. No road improvement in the west would be of greater value to the emigrant or to military operations; and this once done the route would

not only be the shortest one in this latitude from the Missouri to the mountains, but would not throughout have one serious obstacle all the way to the South Pass. Any route that takes the south side of the Platte river has the South Fork to cross, (which is about as difficult a stream as the Loup Fork,) at a point where bridging it or establishing a ferry is, at this time, impracticable; the road then, along the North Fork, has bad places at Ash Hollow and Scott's bluffs, and has to cross the Laramie river and the North Fork of the Platte by bridges, over which the emigrant must pay toll. The route by the north side of the Platte crossing the Loup Fork is, therefore, of particular value, especially for early travel in the spring, when the streams are generally high.

I have spoken of the locality of Omaha being, in my opinion, superior to any other as a point from which to supply the interior portions of the country along the Platte. This in a measure depends upon the improvements being made of the crossing of Loup Fork. At present Nebraska City is a point presenting almost as short a road, which could be made quite so if bridges were placed over a few small streams, and which could be done at an expense to the general government of not more than \$20,000. A considerable distance of river transportation would also be saved to stores brought from St. Louis by selecting Nebraska City instead of Omaha. Besides, the first mentioned must always be a superior point from which to supply Fort Kearny. The cost of river transportation to this point is about 75 cents per 100 pounds. The distance from Nebraska City to Fort Laramie, by the proposed improved route, is about 525 miles. From Fort Leavenworth to Fort Laramie it is about 645 miles.

The price paid for transportation, by the Quartermaster's Department, on these roads, is about \$1 50 per hundred pounds per hundred miles.

It will thus be seen that the transportation of stores to Fort Laramie, by the route from Nebraska City, would be a saving over that from Fort Leavenworth of about \$1 55 per hundred pounds. The total expense from St. Louis via Nebraska City would thus be \$8 62½ per hundred pounds, and I shall use this route in making a comparison of the advantages offered by any route to the north of it.

The first place which apparently offers a superior route is the neighborhood of Fort Randall. Stores can be delivered at this point from St. Louis at a cost of about \$2 25 per hundred pounds. The distance to Fort Laramie is about 380 miles, which, at the rate of \$1 50 per hundred pounds per hundred miles, would give a total cost of about ~~\$5 50~~ \$3 70 per 100 pounds, which would apparently indicate a saving over the Nebraska City route of ~~\$2 82½~~ \$2 92½ per hundred pounds, or ~~about one-third~~. There are two reasons, however, why this great advantage is practically not now attainable: First, the neighborhood of Fort Randall, as a depot for supplies, men, and animals, is not to be compared with Nebraska City; the former being in a comparatively barren country destitute of inhabitants, and where the necessary storehouses can only be constructed at an expense not less than \$100,000. Second, the great difficulties of the route from Fort Randall west. That it is

practicable to take wagons along the Niobrara is shown by our expedition in 1857. The wagons were loaded with about 2,000 pounds, and drawn by eight good mules to each.

Our time of travelling from Fort Laramie to Fort Randall, counting the days necessary to stop to rest the animals, was thirty days. About 100 miles of this route was through sand hills, where I do not think the ordinary transportation trains could have travelled except in the slowest and most fatiguing manner.

The route I have already indicated on the south side of the Niobrara, in my description of that stream, would be preferable to the one we travelled, on account of the sand, but the difficulty of crossing the river would counterbalance the advantage gained by so doing.

The route between Sioux City and Fort Randall is a very good one, and an appropriation of \$10,000 should be made to bridge the Vermilion, for the use of the troops at the fort in hauling supplies from the settlements in Iowa.

This route, and that by the Niobrara, would seem to be the most direct and proper one by which to continue the military road from Mendota to the mouth of the Big Sioux, westward to the South Pass. But the great difficulties of the Niobrara route, and the impracticability of any between it and the Platte, determine me to advise its location direct from Sioux City to the mouth of the Loup Fork.

The road this way, and thence along the Platte valley, will only be about 40 miles longer than by way of the Niobrara. A bridge is required over Middle creek, at a cost of \$5,000; one over the Elk Horn, at a cost of \$20,000; and one over the Loup Fork, at a cost of \$50,000. A good crossing for the Loup Fork could be made for \$25,000.

The next point on the Missouri which claims attention, as one from which to supply Fort Laramie, is the vicinity of old Fort Lookout. A route from this point should keep north of the White river, and intersect the present road from Pierre to Laramie. The eastern portion of the route I have only examined in part, but feel confident that it is a good one, except for about 30 miles through the Bad Lands, in which I have no doubt a route could be found that, with some improvement, would be equal to the corresponding part of the Pierre and Laramie route.

The route west of this would then be the excellent one along the valley of White river, at the head of which a difficult section of about twelve miles needs considerable improvement. This route would be about three hundred and sixty miles from the Missouri to Fort Laramie, and deserves especial consideration as being the proper continuation of the route located between the Missouri and Fort Ripley under the Interior Department, with the design of being continued to the South Pass. Stores can be delivered at Fort Lookout for about three dollars per hundred pounds.

The route from Fort Pierre to Fort Laramie is one that has long been in use, and is about three hundred and twenty-three miles long. Stores can be delivered here for about \$3 50 per hundred pounds. I think it probable, as settlements advance up the Missouri, and

Nebraska and Iowa and Dakota become populated, this route, or the one starting from Fort Lookout, will claim attention.

At Fort Pierre the navigable portion of the Missouri is at its nearest point to Laramie and the South Pass, and above it, of course, there are no competing routes for supplying this section. Neither does the nearest navigable point for steamboats on the Yellowstone or its tributaries offer any route whose diminished length would compensate for the increased river transportation. It is believed that any route which keeps east of the Big Horn mountains is practicable for wagons between the Yellowstone and Missouri, and that the direct route between Fort Laramie and Fort Benton is favorable to military movements.

In consideration of the best routes for supplying the interior, I have mainly had in view the wants of present occupation of the country. When the habitable portions of Nebraska become occupied, as they eventually will, other routes will become important from causes not now operating and that cannot be foreseen; but I believe that those which are now most important will still maintain the ascendancy from the effect of natural causes and the structure of the country. The same routes now most used and best adapted to the wants of military occupation were long before used by the trader, the Indian, and the buffalo, as best adapted to their wants; and when future requirements shall demand increased facilities of transportation and locomotion and railroads shall be built, then they, too, will be found near the main routes now travelled by the trains of the emigrant and the army.

As I before stated, an irreclaimable desert of 200 to 400 miles in width separates the points capable of settlement in the east from those on the mountains in the west. Without doubt these mountain regions will yet be inhabited by civilized men, and the communication with the east will require railroads, independent of the want of an interior overland route to the Pacific. For this purpose the valley of the Platte offers a route not surpassed for natural gradients by any in the world, and very little more is to be done west of the Missouri than to make the superstructure. A cheap road for light trains and engines could easily be built, and when settlements are formed in the mountains will become profitable; and the gold that has been discovered there in valuable quantities may produce this result much sooner than we anticipate. The Niobrara apparently presents a more short and direct route to the interior than the Platte, but its natural features are not so favorable. The direct route from Sioux City to Fort Laramie by the Niobrara would be, for a railroad, about forty miles shorter than by way of the Platte and Fort Kearney.

I do not, however, consider the route by the Niobrara as impracticable, but think that the difficulties in the way of constructing it will overbalance the advantages of being a shorter route from the Missouri. If the route be considered as starting at the city of Chicago, thence *via* Rock Island, Omaha, and the Platte valley, the distance is about the same as that by Dubuque, Sioux City, and the Niobrara; the one large bend which the former makes at Fort Kearney being counterbalanced by the number of small ones of the latter.

A route for a railroad to the Pacific from the neighborhood of St. Paul, by way of the South Pass, would keep on or near the general course of the wagon road lately laid out by Colonel Nobles to the Missouri, at Fort Lookout, and thence along the north side of White river, as before indicated.

Should a route ever be required from the west shore of Lake Superior to the South Pass, it could be located on a very direct and practicable line, *via* Fort Ripley, Lake Traverse, and the Big Shyenne, and deserves examination.

But a route from Lake Superior west to the South Pass would probably not compete in advantages with that examined by Governor Stevens near the forty-ninth parallel. It may, however, be questionable whether one of equally as many advantages could not be found by proceeding directly west from the Bois de Sioux to the Missouri at Fort Clark; thence by way of Knife river to the Yellowstone river at the mouth of Powder river. The valley of the Yellowstone then offers a direct route west to the mountains, where Capt. Clark crossed them in 1856, and thence near the route he pursued to the Bitter Root valley. The more direct route would be down the valley of the Salmon river; but the information we possess of this stream indicates its character through the mountains to be one of great difficulty.

CHAPTER V.

Indians—Military posts—Routes for military operations, &c.

I shall here repeat, with some additions, the account of the Dakotas given in my report of explorations in 1855. The Dakotas are scattered over an immense territory, extending from the Mississippi on the east to the Black Hills on the west, and from the forks of the Platte on the south to Devil's Lake on the north. They say their name means "leagued or allied," and they sometimes speak of themselves as the "Ocheti Shaowni," or "Seven Council Fires." These are the seven principal bands which compose the nation, viz:

1. The Mde-wakan-tonwans, meaning "village of the Spirit Lake."
2. Wah-pe-kutes, meaning "leaf shooters."
3. Wah-pe-tonwans, meaning "village in the leaves."
4. Sisi-tonwans, meaning "village of the marsh."

These four constitute the Mississippi and Minnesota Dakotas, and are called by those on the Missouri "Isanties." They are estimated at 6,200 souls. Some of these on the Mississippi have long been in contact with the white settlements, and having sold much of their lands to the government have abandoned many of their former habits and cultivated the soil. Communities have been formed which have made some approach towards civilization; others of them still live

principally by the fruits of the chase in their primitive wildness, and have of late years occasioned much trouble to the settlers of northern Iowa. It was they who committed the murders last winter on Spirit Lake.

5. Ihanktonwans, (Yanktons,) "village at the end." These are sometimes called Wichiyela, meaning "first nation." They are found at the mouth of the Big Sioux and between it and the Missouri river, as high up as Fort Lookout, and on the opposite bank of the Missouri. They are supposed to number 360 lodges. Contact with the whites has considerably degenerated them, and their distance from the present buffalo ranges renders them comparatively poor. A treaty has been made with them, by which they have ceded most of their land to the United States.

6. Ihanktonwannas, (Yanktonnas,) meaning one of the "end village" bands. They range between James river and the Missouri, as high north as Devil's Lake, number about 800 lodges, and are spirited and warlike, and will give much trouble to the settlers in Dakota territory. They suffered severely from the ravages of the small pox in the winter of 1856 and 1857. A small portion, under a chief called Little Soldier, live in dirt lodges during the summer. From the Wazikute branch of this band the Assinniboinas, or Hohe of the Dakotas, are said to have sprung.

7. The Titonwans, "village of the prairie," are supposed to constitute more than one-half of the whole Dakota nation. They live on the western side of the Missouri, and extend west to the dividing ridge between the Little Missouri and Powder rivers, and thence south on a line near the 106th meridian. They are allied by marriage with the Shyennes, but are enemies of the Pawnees and Crows. The Titonwans, except a few of the Brulés, on White river, and some of the families connected with the whites by marriage, have never planted corn. They are divided into seven principal bands, viz:

1. Unkpapas, "they who camp by themselves." They roam from the Big Shyenne up to the Yellowstone, and west to the Black Hills; to this band Mato Chiqukesa, or the Bear's Rib, belongs, who was made by General Harney the first chief of the Dakotas. They number about 365 lodges.

2. Sihasapas, Blackfeet. Haunts and homes same as the Unkpapas. They number 165 lodges. These two bands have very little respect for the power of the whites.

3. Itazipchos, (Sans Arc,) No bows. Roam over nearly the same territory as the Unkpapas. They number about 170 lodges. It is difficult to say how these bands received their present names. The Itazipchos being as well provided with bows as any other band, and use them as skillfully.

4. Minikanyes or Minni-kan-jous, (meaning they who plant by the water.) They number about 200 lodges, and roam principally from the Black Hills south to the Platte. They are generally well disposed towards the whites.

5. Ogalalas or Okandandas. They number about 460 lodges, and are generally to be found on or near the Platte near Fort Laramie.

They are the most friendly disposed towards the whites of all the Tetonwans.

6. Sichangus, (meaning Burnt Thighs,) Brulés. They number about 380 lodges, and live on the Niobrara and White rivers, and range from the Platte to the Shynne. They include the Wazazhas, to which belonged Matoiya, (the Scattering Bear,) made chief of all the Dakotas by Colonel Mitchell, of the Indian Bureau, and who was killed by Lieutenant Grattan.

7. Oo-he-non-pas, two boilings, or two kettle band. These are now very much scattered among other bands. They number about 100 lodges. Some of them are generally to be found in the neighborhood of Fort Pierre.

The Dakotas, on and west of the Missouri, which includes all but the Isanties, are the only ones I have heard estimated. I should think that eight inmates to a lodge, and one-fifth of them warriors, an ample allowance. We would then have—

Name of band.	Lodges.	Inmates.	Warriors.
Ihanktonwans, (Yanktons) -----	360	2, 880	576
Ihanktonwannas, (Yanktonais)-----	800	6, 400	1, 280
Unkpapas -----	365	2, 920	584
Sihasapas, (Blackfeet)-----	165	1, 320	264
Itazipchos, (Sans Arc) -----	170	1, 360	272
Mini-kan-jous -----	200	1, 600	320
Ogalalas -----	460	3, 680	736
Sichangus, (Brulés)-----	380	3, 040	616
Oo-he-non-pas, (two kettles)-----	100	800	160
	3, 000	24, 000	4, 800

In the summer the Dakotas follow the buffaloes in their range over the prairie, and in the winter fix their lodges in the clusters or fringes of wood along the banks of the lakes and streams. The bark of the cottonwood furnishes food for their horses during the winter snows, and to obtain it many streams have been thinned or entirely stripped of their former beautiful groves. Their horses are obtained by traffic with the Indians further south, who have stolen them in New Mexico, or caught them wild on the plains towards the Rocky mountains; considerable numbers are also raised by themselves. The nation is one of the most skilful and warlike, and most numerous in our Territory, and could they be made to feel more confidence in their own powers, would be most formidable warriors. In single combat on horseback they have no superiors, a skill acquired by constant practice with their bows and arrows and lances, with which they succeed in killing their game at full speed. The rapidity with which they shoot their arrows, and the accuracy of their aim, rivals that of a practiced hand with the revolver. Notwithstanding the destruction of their numbers by small pox and cholera, it is the opinion of some

that they are increasing in numbers rather than diminishing, except where they mingle with the settlements on the frontier.

These Dakotas formerly all lived around the head waters of the Mississippi and Red River of the North, and in their migration to the southwest have been preceded by the Shyennes, (with whom they are on friendly terms,) who have given their name to the Shyenno of Red river, to the Big Shyenno of the Missouri, and to the section of country they now occupy between the Platte and the Arkansas. The Dakotas then lived on much of the land now occupied by the Chippewas, and the Chippewas at that time inhabited the region between the Sault Ste. Marie and Lake Winnepeg, the Crees, their allies, occupying that from Lake Winnepeg and other lakes as far as Kisiskadji-wan (Saskatchewan river) and towards the Assiniboin river. The plains to the south of the last stream were the scene of many contentions and bloody combats, nevertheless, oftener the residence of the Dakotas than of the other two tribes, until that nation was divided into two bodies, originating in jealousy of the women, which ended in their being irreconcilable enemies to this day. The less powerful and flying party took refuge in the rocky precipices of the Lake of the Woods, and received from the Chippewas the name of Assiniboins or Dakotas of the Rocks, under which name they are now generally known to the whites. They however retain, among themselves, the name Dakotas and speak that language. The other Dakotas, in speaking of them, always call them *hohe*, or enemies.

The Assiniboins then allied themselves with the Chippewas and Crees and forced the Dakotas to abandon all the country north of the Shyenno, which is now regarded as the boundary between these tribes.

The Chippewas, Crees, and Assiniboins are friendly to each other and united in their hostility to the Dakotas, and it is improbable that any lasting peace can ever be effected between them. The common war ground is the region about Lake Minniwaken to which they all repair to hunt buffalo. The Assiniboins and Crees may yet occasion us no little difficulty, as a large portion of their lands is in the British territory, they both are now well disposed and friendly. I saw them while at Fort Union in 1856, and they were particular to inform us that they did not want to sell their land and could not spare any of what they now occupy.

These Indians have comparatively few horses, and rely largely on dogs, of which they have great numbers, for transportation. The flesh of these animals also serves them as food. The Assiniboins number about 450 lodges or 3,600 souls. They suffered severely from the small pox in 1856-'57. Their country extends from the Red river west, along the Missouri as far as the mouth of the Milk river.

The Absarakos, or Crows, occupy the country about the Yellowstone and its branches, being bounded on the east by the Dakotas, south by the Platte, and west by the dividing line between the waters of the Atlantic and Pacific.

Their country abounds with everything Indian life requires, and

they are generally well disposed towards the whites, but have as yet seen little of them in their country since 1830, when the trappers were so numerous. They were then much dreaded by these adventurers. The Crows are fine warriors; have plenty of horses, mainly derived from traffic with the Flatheads. They live generally in skin lodges, and number about 600 lodges, or 4,800 souls.

Minnetarres, or *Gros Ventres*. This is a small band of the Crow nation, living in a village of dirt lodges, surrounded by a rude stockade, near Fort Berthold. They raise corn, beans, pumpkins, &c. They number now about 800 souls, but, from a variety of causes, are diminishing.

The *Arricarees*, or *Rees*, are a branch of the Pawnee nation, from which they have become separated by the migration of the Dakotas, and by these latter they are both known by the same name, *Pedanis*.

The *Rees* live in a village near Fort Clark, in a manner exactly similar to the *Gros Ventres*, and number about 840 souls. Formerly they were numerous and powerful, and occupied a large village at the mouth of Grand river. This was destroyed during the expedition under Colonel Leavenworth, sent there in 1825 or 1826 to chastise them for the attack on the trading party of General Ashley. The remains of dirt lodge villages all along the Missouri attest how numerous the Indians of this tribe must have been before the invasion of their lands by the Dakotas.

The *Madans* live in a village, six miles above Fort Clark, in the same manner as the *Gros Ventres*. They seem to be the last remnant of a distinct tribe from any of those around them. They have, through the agency of the small pox, rapidly diminished since they were visited by Lewis and Clarke, and now number about 250 souls. They live in constant dread of the diseases which white men have been at times introducing among them, and the main and oft repeated request which they made to the Indian agent when I was there in July, 1856, was that he would keep sick white men away. When I returned there in September, and saw them again a victim of that scourge, the small pox, brought among them that year by the steamboat of the rival company to the American Fur Company, and saw the despair depicted on every countenance, it made me feel heart sick to think what wrongs these poor savages have suffered from the cupidity of my own race. The authors of this calamity, which visited all the tribes in this region, are fully exposed in the report of the Indian agent, Colonel Vaughan, in 1856-'57.

Bear's Rib, the *Unkpapa*, gave me the following list of persons that died of this disease, from this cause, in 1856 and 1857, that he had heard of, though the disease was still at its work of death in some parts of the Crow country :

	Persons.
Rees.....	166
Hobés	1,500
Big Head's band of <i>Ihanhtonwans</i>	30
<i>Sihasapas</i>	136
	<hr/>
	1,832
	<hr/>

It would be safe to assume the following as probable deaths in tribes not included in this list:

Gros Ventres and Mandows.....	160
Absarakos	1,000
	<hr/>
	1,160
	<hr/>

Making a total of at least 3,000 souls.

Before such blows as this the red race would soon disappear; no war could be so fatal to them. The government should, by all that is humane, employ some competent person, at a proper salary, to visit them yearly, and vaccinate these Indians, and thus arrest the violence of these scourges.

These three little bands, the Gros Ventres, Mandans, and Rees, are fast dwindling away. They never can work much harm to the whites, and their mode of life at a fixed abode requires them to be peaceful. They exist now rather by sufferance of the Dakotas than by their own power, for the Dakotas could soon destroy them if they chose, as they did the villages of the Pawnees, on the Loup Fork, in about the year 1836. The Dakotas find it convenient for themselves to permit the existence of these villages, as their produce of corn, &c., forms a valuable commodity of trade between them.

The *Ponkas* are the small remnant of a once powerful tribe, and now live near the mouth of the Niobrara. They are on friendly terms with the Dakotas. The government agents have lately effected a treaty with them, by which a right to most of their lands has been purchased, and a reserve marked out for their location on the Niobrara and Ponka rivers, near Fort Randal. The treaty has, I believe, not yet been ratified by the Senate. They number about — souls.

The *Pawnees* were formerly one of the most numerous and powerful and warlike of the Indians of the prairie. They have, through the agency of the small pox and their constant wars with the Dakotas and Shyennes, been greatly reduced, and their numbers now do not probably exceed 4,000. They occupy the country on the Platte below Fort Kearny, and on Loup Fork. A treaty was made with them in the winter of 1857, by which they ceded a large portion of their lands to the United States, and agreed to retire to a reserve on the Loup Fork, where were their villages which were destroyed by the Dakotas. This treaty has not yet been ratified.

The *Shyennes* occupy the country between the Platte and Arkansas rivers, and number about — souls. These Indians have always been friends with the Dakotas, and associate much with them. During the summer of 1857, while the vigorous expedition conducted by Col. Sumner was operating against them, a number to the amount of 40 lodges took refuge among the Dakotas, in the neighborhood of the Black Hills.

They will probably unite with the Dakotas, in the event of any general war. Though it is believed, from the great moral effect produced by the march of the Utah expedition through their common

country, that they must see the futility of ever being able to contend against the power of the United States.

Of all the aborigines in the Territory under consideration, the Dakotas are probably the ones that have undergone the least material diminution of their numbers since their discovery by the whites. They are still numerous, independent, warlike, and powerful, and contain within themselves means of prolonged and able resistance to further encroachments of the western settlers. Under the present policy of government, which there is no reason to believe will ever be changed, these encroachments will continue and new wars will result. I do not mean to say that a peaceable advance of the settlements westward might not be effected, but under the operation of present causes it will not. All of these conflicts end in the discomfiture of the native races, and they are fast melting away. It is not, as many suppose, that those dispossessed retire further west; this they cannot do, for the region to the west of one tribe is generally occupied by another with whom deadly animosity exists. Hence, when the white settlements advance their frontier, the natives linger about, till disease, poverty, and vicious indulgence consigns them to oblivion. The present policy of the government seems therefore the best calculated that could be devised for exterminating the Indian.

The advance of the settlements is universally acknowledged to be a necessity of our national development, and is justifiable in displacing the native races on that ground alone. But the government, instead of being so constituted as to prepare the way for settlements by wise and just treaties of purchase from the present owners, and proper protection and support for the indigent race so dispossessed, is sometimes behind its obligations in these respects; and in some instances Congress refuses or delays to ratify the treaties made by the duly authorized agents of the government. The result is, that the settler and pioneer are precipitated into the Indian's country, without the Indian having received the just consideration promised him; and he often, in a manner that enlists the sympathies of all mankind, takes up the tomahawk in defence of his rights, and perishes in the attempt.

It is frequently the case that the settlers are unjustly charged with bringing about these wars, and though I feel for the Indian, I cannot but sympathize with the pioneer whose life is liable to be sacrificed to the Indian's vengeance.

The western settlers are now fighting the battle of civilization exactly as our forefathers did on the Atlantic shores, and under circumstances that command an equal amount of our admiration and approval.

We are in the habit of looking on the power of the United States as invincible, but it is far from being so regarded by the savages on our frontier. Many of them have never seen or felt it. There the Indians far outnumber the whites, and if our sympathies must go with the weak they should be with the settlers, who are only able, after all, to maintain their ground by the aid of the army.

One of the chiefs of the Dakotas told me that they had a grand council in the summer of 1857, on the North Fork of the Shyenne, and that their hearts felt strong at seeing how numerous they were; that if they went to war again they would not yield so easy as they did

before. At that council they solemnly pledged to each other not to permit further encroachments from the whites, and he fully believed they were able to whip all the white men in the world. In truth, they are not without reason in thinking so. They have never seen the whites, except in small parties, stealing through their country, unable to resist them or protect themselves from insolence; or they find them shut up in little trading posts, where for days they dare not, at times, open the gates or show their heads above the enclosure, and where, whenever a band of young warriors wish to have a frolic, they go and shoot their dogs, chickens, cattle, &c., break the windows, and commit any other outrage their fancy may suggest, as a diversion. They have seen the Indian agent, (their father, as he is called,) the direct representative of the President, insulted and abused with impunity by their own race and sometimes in dread of losing his life, and they, many of them, entertain no respect for the power of our government. Numbers of them have never seen a soldier of the United States army, and scarce credit their existence.

Bear's Rib (a great friend to peace with the whites and the most influential warrior in his nation) said his people could not be controlled by him, and that if he should attempt it in some cases his own life would be the forfeit.

There are so many inevitable causes at work to produce a war with the Dakotas before many years, that I regard the greatest fruit of the explorations I have conducted to be the knowledge of the proper routes by which to invade their country and conquer them. The Black Hills is the great point in their territory at which to strike all the Teton Dakotas, except the Brulés and Okandandas. Here they can assemble their largest force, and here I believe they would make a stand. In the event of another outbreak, a post should be established at the mouth of the Shyenne, on the north side, from which to operate simultaneously with troops from Fort Laramie. From both of these points wagon trains could move with ease, and supplies could without difficulty be sent thus to the troops in the field. These operations would undoubtedly bring on a battle, where the superiority of the weapons of civilized warfare would secure a victory to us. They will not, I think, permit the occupation of the vicinity of these hills without offering a determined resistance. Driven from these they must go north towards the Missouri, where a still better field to operate against them will be found, as this region is every where practicable. In this event it might become necessary to establish a temporary post above the Shyenne, and a most suitable and effective location is to be found near Long Lake, on the Missouri.

Those who may take refuge in the ravines and fastnesses along the Niobrara, or in the sand hills, could be operated against from forts Randall, Kearny, and Laramie. Should the Isanties and Ihankton-~~mans~~ be hostile at the same time as the Tetonwans, they should be operated against from Fort Ridgeley.

It will be perceived that in this plan I have considered a war with all the Dakotas to be on our hands, which at no distant day is probable, and that there will be required a number of columns and a very large force to successfully operate over so much country. These

columns need not exceed in any case a strength of 400 men, and these should be subdivided so as to beat up the country as much as possible, and endeavor to draw the Indians into an engagement where they may have some hope of success. With proper troops and commanders we need not even then fear the result.

The movement of large compact columns is necessarily slow and they can easily be avoided, which the least military skill teaches the Indians to do. The war once begun should not be stopped till they are effectually humbled and made to feel the full power and force of the government, which is a thing in which the northern Dakotas are entirely wanting.

I believe a vigorous course of action would be quite as humane as any other, and much more economical and effectual in the end. With proper arrangements the Assiniboin and Crows and Pawnees could be made most useful allies in a war with the Dakotas. I see no reason why they should not be employed against each other, and thus spare the lives of the whites.

In giving my opinion of the best way of bringing the Dakotas to submission, in the event of a war, I think it my duty to state that I believe many of the causes of war with them might be removed by timely action in relation to the treaties, which are from time to time made with them, and a prompt and faithful fulfillment of our own part of the stipulations, and it is to be hoped that Congress will afford the means of carrying into effect the treaty made by General Harney in 1856, and those made by the Indian bureau in 1857 with the Ihanktonwans and Poncas, and that it will provide liberally for those who have been dispossessed of their lands or impoverished by having their game driven off by the approach of the whites.

I have always found the Dakotas exceedingly reasonable beings, with a very proper appreciation of what are their own rights. What they yield to the whites they expect to be paid for, and I never have heard a prominent man of their nation express an opinion in regard to what was due them in which I do not concur. Many of them view the extinction of their race as an inevitable result of the operation of present causes, and do so with all the feelings of despair with which we should contemplate the extinction of our nationality.

WASHINGTON, D. C., *January 31, 1858.*

SIR: I submit a report of the most important cases of sickness that required medical treatment in the party under your command, from June 15 until December 4, 1857.

After the party reached the Loup Fork it was necessary to remain in camp for a number of days awaiting the arrival of the escort. The mouth of that stream was reached July 4, and we encamped near the river not far from the town of Columbus. It was in this locality that the most serious cases of illness which occurred in the party were generated. In passing up the Platte we travelled principally at some distance from the stream. Near the river, and along some of its tributaries, swampy districts of country exist which might endanger the health of persons living in their vicinity during the summer and autumn. I noticed long marshy tracts of this kind overgrown with heavy vegetation along the Loup Fork at this point. Soon after our encampment a good deal of bilious derangement prevailed in the party, and the presence of miasmatic poisons was soon made apparent in the occurrence of a number of cases of intermittent fever. Nearly all of the party experienced unpleasant disturbances of health here. The season had been unusually wet and the heat was extreme. Vegetation was consequently developed very rapidly, and it was, therefore, not difficult to account for the early appearance of disease among us. Under ordinary circumstances I would consider this region as healthy as most prairies, but the past seasons were particularly favorable to the development of malaria. All of the cases, however, that were treated here yielded readily, and when we commenced our journey up the Loup Fork no complaint was heard.

We seemed, however, peculiarly unfortunate in the start; for, a few days after we had got finally under way, the most serious case of sickness which we had to encounter during the trip commenced. On July 23, May, a teamster, exhibited the symptoms of fever, and it soon became apparent that this man must suffer a long and severe illness; under the most favorable circumstances his chances for recovery would have been considered few, and the circumstances under which we were of necessity placed tended greatly to diminish those chances. Delay was out of the question, as his case, if it resulted favorably, would require at least a fortnight, and we therefore placed him in the best situation that was possible in travelling and did all in our power to promote his recovery. This case was an interesting one to the medical practitioner; it was one of those in which the signs and symptoms of typhoid and of remittent bilious fevers were intimately blended. Delirium commenced early, with stupor, diarrhœa, and that peculiar condition of the tongue and mouth noticed in typhoid fever; with these some of the common symptoms of remittent fever were exhibited, and although the attack could not be cut short by quinia, its violence was greatly modified by that agent. The sickness of this man embarrassed our progress seriously, but after nearly three weeks of trouble and anxiety with his case we were gratified to note his convalescence. A halt of three days during the most excited period of his disease tended greatly to promote a favorable termination. May

was hauled the entire distance to Fort Laramie, not being able to perform any duty until we reached that point. On the 8th of August I was attacked with bilious remittent fever myself, and can testify from experience to the inconvenience from being sick on the prairies. My attack was not severe, and yielded in eight or ten days. These and the cases of intermittent were the only cases of fever that occurred in the party during the season.

The country through which we passed up to this point was along the Loup Fork. That portion of it most favorable to the production of fever is near its mouth; as you approach the sources of the river there are fewer wet tracts near the stream, and the country generally is not so flat. I notice the marshes particularly, as that is the only condition observed which could interfere with the health of the population if the country were inhabited. These are not numerous after you leave the mouth of the river some distance, and there is nothing to warrant the inference that the country is not highly favorable to health.

Indeed, in most respects, this region, so far as health is concerned, may be considered as highly favored. As you approach the elevated regions near the mountains the atmosphere is exceedingly dry and pure. Much has been said of the favorable effects of a residence in this region upon persons laboring under pulmonary diseases. As this far western region becomes more generally known, I think the subject will attract greater attention. I think the rational explanation of the improvement in consumptive cases that has been noted in this quarter is found in the dryness of the atmosphere. Sudden changes of temperature here, if not less frequent than in some of our eastern States, are certainly not productive of the same bad consequences to the invalid. The lungs of those who are suffering with phthisis are here free from that constant irritation to which they are subjected in an atmosphere loaded with moisture. And the feeling of buoyancy and strength that is imparted encourages the invalid to make new exertions to promote recovery. A residence in such an atmosphere, combined with habits of active exercise, and constant living in the open air, might, in some cases I am sure, be productive of the best results. An intelligent friend, now residing at Fort Laramie, informed me that in his youth he was attacked with phthisis, that horrible disease being hereditary in his family; he was rapidly declining, and went to this far western region in the hope that the climate might prove beneficial; he made his home amongst the wandering bands of Indians, and avoided none of the exposure incident to such a life; he laid constantly in the open air and took as much exercise as possible; his health improved, and in a year or two he was entirely restored, and is now residing at Fort Laramie a strong and healthy man. I have heard of many other cases similarly restored. In New Mexico consumption is unknown, I am informed, as a disease originating in the country where the climate has the additional advantage of being warm.

During the extremely hot weather that continued during our journey up the Loup Fork, our party suffered very little with diarrhoea or dysentery. A number of cases of the former occurred, but only a few required any treatment, and but a single case of dysentery, which

was mild. After reaching Fort Laramie those who had been sick rapidly recovered, and when we left that post all of the party were in excellent health.

During the fine weather that continued for a few weeks in the beginning of the fall no cases of sickness occurred. In October the weather became inclement, and was very cold and wet. During our trip down the Niobrara no complaint was heard, except in some chronic cases, which were somewhat aggravated by the bad weather and exposure, and when the party reached Fort Randall all were in good health. Several of the soldiers had suffered from scurvy during the summer, these improved during the trip down the Niobrara, along which stream we found an abundance of plums and grapes. After leaving Fort Randall (November 7th) the members of the party were attacked with influenza, and this disease prevailed during the entire trip from Randall to Leavenworth, and only four or five members of the party escaped an attack. Some of the men, who were much exposed to the inclement weather that we experienced on the trip, suffered severely, and at times a sufficient number were not off of the sick list to carry on the train properly. All recovered, however, and when we reached Leavenworth the party was in good health. Below is an enumeration of the most important cases treated during the season. Many trifling cases occurred of which no note was taken.

Diseases.	No. cases.	Results.
Intermittent fever.....	5	Recovered.
Bilious remittent.....	2	Recovered.
Diarrhea.....	5	Recovered.
Dysentery.....	1	Recovered.
Gonorrhea acute.....	3	Recovered.
Orchites.....	1	Recovered.
Gleet.....	3	Recovered.
Chronic cystitis.....	1	Recovered.
Diabetes.....	1	Improved.
Granular conjunctivitis.....	1	Improved.
Tarsal ophthalmia.....	1	Recovered.
Influenza.....	11	Recovered.

Respectfully,

SAMUEL H. MOFFITT,
Physician to expedition.

Lieutenant G. K. WARREN,
Topographical Engineers.

EXPLORATIONS IN NEBRASKA AND DAKOTA.

CATALOGUE OF THE COLLECTIONS

IN

GEOLOGY AND NATURAL HISTORY,

OBTAINED BY

THE EXPEDITION UNDER COMMAND OF LIEUT. G. K. WARREN,
TOPOGRAPHICAL ENGINEERS,

BY

F. V. HAYDEN, M. D.

WASHINGTON, D. C., *November* 28, 1858.

SIR: In compliance with your request I have prepared a catalogue of the collections in geology and natural history, obtained in Nebraska and portions of Kansas, during several expeditions to those Territories under your command.

The list cannot be made out at this time as complete as could be desired, but it will be at once evident to all that the amount of new and valuable material thus secured, will, when properly studied and illustrated, form a large and positive addition to science. Of the fossil mollusca collected most of the new species have been indicated in scientific journals by my associate, Mr. Meek, and myself, and about

seven hundred figures prepared, making, when arranged for the engraver, about fifty quarto plates. The fossil plants from cretaceous formation No. 1 will also be included in the volume, and consist of eighteen species, all of which are supposed to be new to science. The fossil plants of the tertiary era, of which there is a large series, remarkably well preserved and of great beauty, have not yet been studied to any extent. We simply know that they comprise about fifty species, all of which are supposed to be new, and would alone form a good-sized quarto volume. Descriptions and suitable illustrations of these plants will be made during the winter or spring.

The fossil mollusca are arranged in their stratigraphical order, thus bringing at once before the geologist the characteristic fossils of each formation known in the northwest, from the carboniferous to the tertiary, inclusive. The work will thus form a standard of reference for those who may wish to study the geology of the west, and will enable the explorer, even though but moderately versed in the science, to determine the age of the formations over which he may be travelling. The fossil vertebrata, which are very numerous in species, a large proportion of which were entirely new to science, have been placed in the hands of Dr. Leidy, the great comparative anatomist of Philadelphia, who informs us that the drawings are nearly ready for the engraver.

The following is a list of the memoirs already published in the transactions of scientific societies on the geology and paleontology of Nebraska and Kansas, by F. B. Meek and F. V. Hayden.

1. Descriptions of sixty-three new species of *Acephala*, *Gastropoda* and *Cephalopoda* from the cretaceous formation of Nebraska Territory.—(Proceedings of the Academy of Natural Sciences, Philadelphia, March, 1856, p. 16.)

2. Descriptions of new species of *Acephala* and *Gastropoda* from the tertiary formations of Nebraska Territory, with some general remarks on the geology of the country about the sources of the Missouri river.—(Proc. Acad. Nat. Sci. Pa., June, 1856, p. 16.)

3. Descriptions of new fossil species of mollusca, collected by Dr. F. V. Hayden in Nebraska Territory, together with a complete catalogue of all the remains of *invertebrata* hitherto described and identified from the cretaceous and tertiary formations of that region.—(Proc. Acad. Nat. Sci. Pa., November, 1856, p. 22.)

4. Descriptions of new species and genera of fossils collected by Dr. F. V. Hayden in Nebraska Territory, under the direction of Lieut. G. K. Warren, U. S. Topographical Engineers, with some remarks on the tertiary and cretaceous formations of the northwest, and the parallelism of the latter with those of other portions of the United States and Territories. Communicated by permission of the Secretary of War.—(Proc. Acad. Nat. Sci. Pa., May, 1857, p. 34.)

5. Descriptions of new organic remains from northeastern Kansas, indicating the existence of permian rocks in that Territory.—(Transaction of the Albany Institute, vol. IV—read March 2, 1858.)

6. Descriptions of new organic remains collected in Nebraska Territory in the year 1857, by Dr. F. V. Hayden, geologist to the ex-

ploring expedition under the command of Lieut. G. K. Warren, Topographical Engineers, U. S. A., together with some remarks on the geology of the Black Hills and portions of the surrounding country.—(Proc. Acad. Nat. Sci. Pa., March, 1858, p. 19.)

By F. V. HAYDEN :

7. Notes explanatory of a map and section, illustrating the geological structure of the country bordering on the Missouri river, from the mouth of the Platte to Fort Benton in latitude $47^{\circ} 30' N.$, longitude $110^{\circ} 30' W.$ —(Proc. Acad. Nat. Sci., Pa., May, 1857, p. 10.)

8. Notes on the geology of the Mauvais Terres of White river.—(Proc. Acad. Nat. Sci., Pa., June, 1857, p. 8.)

9. Explanations of a second edition of a geological map of Nebraska and Kansas, based upon information obtained during an expedition to the Black Hills, under the command of Lieutenant G. K. Warren, topographical engineers, United States army.—(Proc. Acad. Nat. Sci., Pa., June, 1868, p. 22.)

Dr. Leidy's descriptions of the new *vertebrata*, collected from time to time, are distributed through various numbers of the proceedings of the Philadelphia Academy for the years 1856, 1857 and 1858. The principal paper was published in March last, and bears the following title: "Notice of remains of extinct *vertebrata* from the valley of the Niobrara river collected by Dr. F. V. Hayden, geologist to the expedition, under the command of Lieutenant G. K. Warren, topographical engineers, United States army, by Joseph Leidy, M. D." The details of the geology of the regions explored will be reserved for your final report.

The following is the number of species comprised in the collection from each department of natural history as far as they have been studied, up to this time. The catalogue includes none of the insects of which there are many species, nor the cryptogamic plants which have not yet been identified.

Number of species of fossil <i>vertebrata</i>	77
Number of species of fossil mollusca.....	251
Number of fossil plants.....	70
Number of minerals and geological specimens.....	423
Number of species of recent mammals.....	47
Number of species of birds.....	186
Number of species of recent mollusca.....	65
Number of species of fishes.....	24
Number of species of reptiles.....	28
Number of species of recent plants.....	1,500

Of the fossil mollusca named in this catalogue 186 species were new to science, upwards of 50 of the *vertebrata* and all the fossil plants are supposed to be new. A number of rare or entirely new species were discovered in all departments of natural history. The specimens are now deposited in the museum of the Smithsonian Institution, and in behalf of the expedition I would return my grateful thanks to the

distinguished Secretary of that Institution for the numerous facilities he has very kindly afforded for their investigation.

F. V. HAYDEN,
Geologist and Naturalist.

Lieutenant G. K. WARREN,
Topographical Engineers, U. S. A.

GEOLOGY AND PALEONTOLOGY.

In order to render this catalogue something more than a mere list of species, I have attempted to present a summary of the geological formations, as far as they are at present known, in Kansas and Nebraska. This will render more clear the geological relations of the fossils from the Potsdam sandstone to the pliocene tertiary.

The rocks of Nebraska, as far as they are at present known, are referrible to the following geological systems:

1. Metamorphosed azoic rocks, including coarse granite.
2. Lower Silurian. (Potsdam sandstone.)
3. Devonian.
4. Carboniferous.
5. Permian.
6. Jurassic.
7. Cretaceous, Upper, Middle and Lower (including Wealden?)
8. Tertiary.
9. Post Pliocene or Quaternary.

Passing over the granitic and azoic rocks, we find that the Potsdam sandstone or the lowest member of the silurian period is quite well developed in the Black Hills. It is there brought to the surface by the upheaval of the igneous rocks and forms a narrow belt around the most elevated portion of the Black Hills. This formation, though well known and studied in many parts of the United States, had not been discovered in the region of the Rocky mountains prior to Lieutenant Warren's exploration of the Black Hills, during the summer of 1857. So far as is yet understood, this member of the geological series has revealed the first indications of organic life on our planet. The following species of fossils, belonging to what Barrande, the great paleontologist of Bohemia, has called the "Primordial Fauna," have been identified from the Potsdam sandstone of the Black Hills and suitable illustrations prepared. *Lingula antiqua*, (Hall;) a species of *Lingula* very similar to *L. prima*, (Conrad,) occurs in vast numbers, forming layers several inches in thickness; a species of *Obolus*, very closely allied to *O. oppolinus*, as figured by Muchison and De Verneuil in their work on the geology of Russia, and fragments of a *trilobite*, apparently identical with one of the forms figured by Dr. Owen from the Potsdam sandstone of Minnesota.

The discovery of this formation in the far west is a matter of the highest geological interest, and its existence in the Black Hills being now well established, we may look for its discovery in many other parts of the west, and it will undoubtedly be found holding a similar position all along the eastern slope of the Rocky mountains.

No well marked fossils have yet been obtained from the supposed devonian period in Kansas or Nebraska, and its existence there is, with our present evidence, quite problematical.

A large collection of fossils was secured from the carboniferous group, in the Black Hills, near the Laramie range of mountains, in the southeastern portion of Nebraska, and in various parts of Kansas. A large and fine collection of carboniferous and permian fossils were collected by Mr. F. B. Meek and the writer, in Kansas, during the past summer. These fossils are now being investigated at the Smithsonian Institution. I will therefore omit a catalogue of the carboniferous fossils until our results are more complete. The organic remains from all the localities above mentioned, as well as from many other parts of the west and southwest, have several species in common, and the others are of the same types; so that the evidence seems to be conclusive that these limestones are all of the same geological age, and belong to the true coal measures.

One of the most interesting series of rocks in the west are best developed in Kansas, but most probably exist near the Black Hills also. These rocks were at first supposed to be the American representatives of the permian group of Europe; but much more study will be required to give them their exact position in the geological scale. A large collection of fossils from these rocks has been studied with considerable care by Mr. Meek and the writer, and they seem to warrant the conclusion that by far the greater portion of the strata of the so-called permian in the west hold an intermediate position between the carboniferous and the permian of the Old World. A thorough and clear solution of this problem becomes, therefore, the most interesting feature in American geology at the present time.*

The following species, most of which are of permian types, have been described by Mr. Meek and the writer, and published in the Transactions of the Albany Institute. The larger part of them were obtained by Mr. Hawn and Dr. Cooper in Kansas, and the remainder were collected by the writer in Nebraska, opposite the northern boundary of the State of Missouri, and in the Black Hills, while attached to Lieutenant Warren's party:

1. *Monotis Hawni*; Meek and Hayden.
2. *Myalina (Mytilus) perattenuatus*; Meek and Hayden.
3. *Bakevellia parva*; Meek and Hayden.
4. *Edmondia? Calhouni*; Meek and Hayden.
5. *Pleurophorus? occidentalis*; Meek and Hayden.

* The upper portion of the so-called permian in Kansas seems to be destitute of true carboniferous fossils, but contains an abundance of those belonging to permian types. We are therefore of the opinion that the upper two or three hundred feet of these rocks are probably on a parallel with the permian of Europe, and that the intermediate group which we have mentioned fills up the hiatus between the carboniferous and permian of the Old World.

6. *Pleurophorus (Cardinia) subcuneata*; Meek and Hayden.
7. *Lyonsia (Panopaea) concava*; Meek and Hayden.
8. *Panopaea Cooperi*; Meek and Hayden.
9. *Nautilus eccentricus*; Meek and Hayden.
10. *Leda (Nucula) subscitula*; Meek and Hayden.

A fine series of fossils, which we have supposed to be of jurassic age, were obtained from the Black Hills during the summer of 1857. None of the species, so far as examined, seem to be positively identical with those found in the jura of Europe, but they all belong to the same genera, and many of the species are closely allied to forms which are characteristic of that period in the Old World. In order to render more clear our opinion that these fossils are jurassic, I will repeat, in connexion with the names of each species, the evidence derived from the study of the fossils, which has already been published by Mr. Meek and myself, in March, 1858:

1. *Lingula brevirostris*, Meek and Hayden.
2. *Avicula (Monotis) tenuicostata*, M. and H., a closely allied representative of the liassic species *Monotis substriata*, Munster.
3. *Mytilus pertenuis*, M. and H.
4. *Arca (Cucullea) inornata*, M. and H. Very similar to *C. Munsteri* (Leiten) from the Lias.
5. *Panopaea (Myacites) subelliptica*, M. and H. Very similar to the liassic forms, *M. liassensis* and *M. Alduininus* of Quensted.
6. *Ammonites cordiformis*, M. and H., may be regarded as the American representative of the European liassic species, *A. cordatus* of Sowerby.
7. *Ammonites Henryi*, M. and H.
8. *Belemnites densus*, M. and H. This species is so closely allied to the oolitic *B. eccentricus*, Blainville, that we are in great doubt whether it is really distinct. It is also allied to the *B. panderianus* of d'Orbigny, from the lower oolite.
9. *Pentacrinus asteriscus*, M. and H., so closely resembles the *P. scalaris*, Golfuss, that it was with considerable hesitation that it was described as new.

From the above evidence we think we may safely consider the group of rocks from which the fossils were collected as the American representative of the jurassic rocks of the Old World. We have still in the collection several undescribed species, which are all of jurassic types.

There is, also, at the base of No. 1, in the Black Hills, a fresh water deposit, which we are in doubt whether to place with the jurassic or lower cretaceous. The fossils are a species of *Unio*, (*U. nucalis*, Meek and Hayden,) and a small *Planorbis*.

Near the mouth of the Judith river, on the Missouri, is a most interesting series of strata, deposited in a basin-like depression in cretaceous formation, No. 1. These beds are composed of sand, sandstone, clays, and very impure lignite, with remains of fresh water, land, and a few estuary shells; also, remains of saurians, turtles, fishes, &c. The exact age of this deposit has not yet been determined, the mollusca pointing to the conclusion that it belongs

to the tertiary period, while the vertebrata are considered by Dr. Leidy to belong to Wealden types and allied to those forms, discovered by Dr. Mantell, in the Wealden strata of England. With evidence so conflicting before us, it will be necessary to make a second exploration of that region before we can come to any positive conclusion as to its age. The following section, in descending order, will represent the different beds with sufficient accuracy and detail for our present purpose.

Section of fresh water and estuary deposits near the mouth of Judith river.

A.	80 feet..	Yellow arenaceous marl passing downwards into gray grit, with small seams of lignite; contains great numbers of <i>Ostrea subtrigonalis</i> ?, <i>Cyrena occidentalis</i> , <i>Melania convexa</i> , &c.
B.	10 feet..	Impure lignite, containing much sand. <i>Ostrea subtrigonalis</i> ? and silicified wood.
C.	80 feet..	Alternations of sand and clay, with particles of lignite; also reddish argillaceous concretions with a few saurian teeth, and fresh water shells.
D.	20 feet..	Alternate strata of sand and clay, with impure lignite and silicified wood in a good state of preservation.
E.	100 feet..	Variable bed, consisting of alternations of sand and clay with large concretions containing great numbers of <i>Melania</i> , <i>Paludina</i> , <i>Helix</i> , <i>Planorbis</i> , <i>Cyclas</i> , &c., associated with saurian remains resembling the <i>Iguanodon</i> and <i>Megalosaurus</i> , <i>Trionyx</i> , &c.
F.	25 feet..	Alternations of impure lignite and yellowish-brown clay, the latter containing great numbers of <i>Unio</i> , <i>Paludina</i> , <i>Melania</i> , <i>Cyclas</i> , and the fresh remains referred by Dr. Leidy to the genus <i>Lepidotus</i> .
G.	100 feet..	Ferruginous sand and clay, having in upper part a seam three or four inches in thickness, nearly made up of shells of <i>Unio</i> . Lower part ferruginous and coarse gray grit, with a seam near the base entirely composed of remains of <i>Unio Danai</i> , <i>U. Dewyi</i> , and <i>U. subspatulata</i> .

The cretaceous group, which occupies so extensive an area on the Upper Missouri, has been separated into five divisions, which present well marked lithological differences and contain, for the most part, distinct species of organic remains.

Vertical section of the cretaceous formations of Nebraska Territory, so far as determined.

CRETACEOUS SYSTEM.

No. 5.	Gray and yellowish arenaceous clays, and sandstones, sometimes weathering to a pink color; containing <i>Belemnitella bulbosa</i> , <i>Nautilus Dekayi</i> , <i>Ammonites placenta</i> , <i>A. lobatus</i> , <i>Scaphites Conradi</i> , <i>Baculites ovatus</i> , and great numbers of other marine mollusca.		Moreau trading post and under the tertiary at Sage and Bear cr'ks. Fox hills.	100 to 150 feet.
No. 4.	Bluish and dark gray plastic clays, containing <i>Nautilus Dekayi</i> , <i>Ammonites placenta</i> , <i>Baculites ovatus</i> , and <i>B. compressus</i> , with numerous other marine mollusca—remains of <i>Mosasauros</i> .		Great area about Ft. Pierre and along the Missouri below there. Under No. 5, at Sage and Bear cr'ks. Great Bend of the Missouri. Near Milk and Muscle Shell rivers.	350 feet.
No. 3.	20 feet.	Dark, very fine unctuous clay, containing much carbonaceous matter, with veins and seams selenite, sulphuret of iron, fish and scales, (local.)	Bluffs along the Missouri, below the Great Bend. Extends to Big Sioux river, and occurs along the latter stream.	150 feet.
	100 feet.	Lead gray calcareous marl, weathering above to a yellowish tint. Scales and other remains of fishes— <i>Ostrea congesta</i> —passing downwards into		
	30 feet.	Light gray or yellowish limestone, containing great numbers of <i>Inoceramus problematicus</i> , fish scales, and <i>Ostrea congesta</i> .		
No. 2.	Dark gray laminated clay scales and other remains of fishes, small Ammonites, <i>Inoceramus problematicus</i> ?, <i>Serpula</i> , small oyster-like <i>O. congesta</i> , &c, &c.		Along the Missouri Bluffs, from ten miles above James river to Big Sioux river.	90 feet. Wanting in
No. 1.	Yellowish and reddish friable sandstone, with alternations of dark and whitish clays. Seams and beds of impure lignite, fossil wood, impressions of dicotyledonous leaves; <i>Solen</i> , <i>Pectunculus</i> , <i>Cyprina</i> , &c. Lower cretaceous.		Near the mouth of Big Sioux river, and between there and Council Bluffs. Near Judith river?	90 to 100 feet, or more.

Formation No. 1 seems to constitute paleontologically an independent division, none of its organic remains ranging in other formations above or below. Nos. 2 and 3 seem to form one group, the *Ostrea congesta* and *Inoceramas problematicus* passing from one to the other. Divisions 4 and 5, which are the most fossiliferous formations on the Upper Missouri, contain many species in common, especially of the Cephalopoda, and therefore form a third group.

The cretaceous system, as developed on the Upper Missouri, therefore forms lithologically five well marked subdivisions, while paleontologically it admits of separation into three independent groups. The age and geological position of divisions 2, 3, 4, and 5, have been sufficiently attested by the numerous species of organic remains which have been published, from time to time, by my associate, Mr. Meek, and myself. In regard to the age of No. 1 much doubt existed, until we had an opportunity to examine a fine series of Dicotyledonous leaves, which I had discovered in this formation near Blackbird Hill, on the Missouri, while attached to Lieutenant Warren's party, in the spring of 1857. These leaves proved to us that the formation under consideration could not be older than cretaceous, and this conclusion was published by us in several of our later papers. Although the evidence that it is of lower cretaceous age was perfectly satisfactory to us, some writers have considered it triassic, while others have regarded it as jurassic and even miocene tertiary. In a late publication addressed to Mr. Meek and the writer, Professor Marcou says: "Allow me respectfully to suggest to you that I cannot see anything of cretaceous in what you call No. 1 of your Nebraska section. It appears to me that you put in your No. 1, or lower cretaceous, all sorts of strata of different ages, except true cretaceous rocks." That the rocks in question are not newer than cretaceous I will endeavor to prove, both from stratigraphical and paleontological evidence.

Evidence from stratigraphical position.

Near the old Otoe village, on the Platte river, about five miles above its mouth, No. 1 rests directly upon limestone strata of the true coal measures; and at this point I found a species of *Laurus*, apparently identical with a plant obtained near the mouth of the Big Sioux, and at Blackbird Hill. Near De Soto, about twenty miles above Omaha City, the carboniferous limestone ceases to appear, and No. 1 rests with concordant stratification upon it. There is not the slightest disturbance of the strata in this region, but they dip gently toward the northwest. I traced No. 1 with great care to Blackbird Hill, about sixty miles above De Soto, and found a few plants at different localities. At Blackbird Hill an extensive quarry had been opened to procure stone for building the large mission establishment at that place. From this quarry I collected the fine series of dicotyledonous leaves, before mentioned. I then directed my course toward the mouth of the Big Sioux, about forty miles further up the Missouri, and examined the country with great care. The red sandstone, No. 1, was the principal rock in that region, but upon the summits of the bluffs, resting

upon the sandstone apparently, I often found layers of a yellowish white rather soft limestone, fully charged with *Inoceramas problematicus* and fish remains. Near Sioux City, about two miles below the mouth of Big Sioux river, is a vertical section of No. 1, rising about thirty feet above the water's edge. At the base of this vertical cut I collected a number of leaves, similar to those observed at Blackbird Hill. From the high bluffs, bordering upon the Missouri, the inhabitants of this region obtain immense quantities of the calcareous rock of No. 3, composed almost entirely of *I. problematicus*, and convert it into lime. On the Big Sioux river, about six miles above its mouth, I took the following section of the strata from a vertical cut with considerable care. Yellow marl, a recent deposit.

No. 3. Shaly limestone, gradually passing into bed below, with an abundance of *Inoceramas problematicus*, and fish remains.

No. 2. Dark plastic shaly clay, with ferruginous concretions.

No. 1. *a*—Yellow friable sand.

b—Earthy lignite, 6 inches.

c—Variegated sandstones and clays, extending to water's edge, with Dicotyledonous leaves.

Section near the mouth of Iowa creek.

No. 3. Gray and yellow marl, with immense numbers of *I. problematicus*, *Ostrea congesta*, and fish remains.

No. 2. Dark plastic clay with *Ammonites* resting concordantly upon the bed below.

No. 1. Sandstone just above water edge.

At this last locality I found in No. 1 the plant which Prof. Heer refers to, *Laurus primigenia*, and a shell which we have described as *Solen Dakotaensis*. Here No. 1 passes from sight beneath the well known cretaceous bed No. 2.

With regard to our No. 1 holding a position beneath well marked cretaceous beds, I think I need not say anything further.

Paleontological evidence.

The fine series of fossil plants from No. 1, which I collected on the Missouri, as well as those obtained by my friend, Mr. Meek, and myself, during our recent trip to Kansas, were placed in the hands of our friend, Dr. J. S. Newberry, the well known authority in fossil botany, and from him we received the following notes:*

"They include so many highly organized plants, that were there not among them several genera exclusively cretaceous, I should be disposed to refer them to a more recent era."

"A single glance is sufficient to satisfy any one they are not triassic. Up to the present time no angiosperm dicotyledonous plants have been found in rocks older than cretaceous, while of the eighteen species which comprise your collection, sixteen are of this character."

The species of your fossil plants are probably all new, though gen-

* Dr. Newberry's remarks will appear in the January number of Silliman's Journal with our joint paper.

erally closely allied to the cretaceous species of the Old World. From the limited study I have given them, I have referred them to the following genera :

Sphenopteris,
Abietites,
Acer,
Fagus,
Populus,
Cornus,
Liriodendron.

Pyrus,
Alnus,
Salix,
Magnolia,
Credneria,
Ettingshausinia,

“Of these the last two are exclusively cretaceous and highly characteristic of that formation in Europe.”

From the evidence which we have given, we think we are warranted in regarding our No. 1 as cretaceous, and probably of lower cretaceous age. This matter will be discussed more fully hereafter. The red sandstone at the mouth of Big Sioux is the type of our No. 1, and its relations to the sandstone strata, near the Judith river, are not positively determined.

Table showing the stratigraphical position of the cretaceous fossils hitherto identified from Nebraska Territory.

	Formations in ascending order.				
	1	2	3	4	5
1. GENUS CALLIANASSA.					
1. <i>Callianassa Danai</i> , Hall & Meek				*	
2. GEN. BELEMNITELLA.					
2. <i>Belemnitella mucronata</i> , Schlotheim				*	
3. <i>Belemnitella? halhaser</i> , Meek & Hayden				*	
3. GEN. NAUTILUS.					
4. <i>Nautilus De Kayi</i> , Morton				*	*
4. GEN. AMMONITES.					
5. <i>Ammonites placenta</i> , De Kay				*	*
6. <i>Ammonites lobatus</i> , Tuomy				*	*
7. <i>Ammonites opalus</i> , Owen					
8. <i>Ammonites complexus</i> , Hall & Meek				*	
9. <i>Ammonites percarinatus</i> , Hall & Meek		*	*		
10. <i>Ammonites Halli</i> , Meek & Hayden				*	
5. GEN. TUNILITES.					
11. <i>Turrilites Nebrascensis</i> , Meek & Hayden					
12. <i>Turrilites Cheyennensis</i> , Meek & Hayden					
13. <i>Turrilites umbilicatus</i> , Meek & Hayden					
14. <i>Turrilites (Helicoceras) cochleatus</i> , Meek & Hayden					

TABLE—Continued.

	Formations in ascending order.				
	1	2	3	4	5
6. GEN. ANCYLOCERAS.					
15. <i>Ancyloceras</i> ? <i>Nicolletti</i> , Hall & Meek	-----	-----	-----	*	-----
16. <i>Ancyloceras</i> ? <i>Mortoni</i> , Hall & Meek	-----	-----	-----	*	-----
17. <i>Ancyloceras</i> (<i>Hamiles</i>) <i>uncus</i> , Meek & Hayden	-----	-----	-----	*	-----
7. GEN. PTYCHOCERAS.					
18. <i>Ptychoceras</i> <i>Mortoni</i> , Meek & Hayden	-----	-----	-----	*	-----
8. GEN. HELIOCERAS.					
19. <i>Helioceras tenuicostatus</i> , Meek & Hayden	-----	-----	-----	*	-----
20. <i>Helioceras</i> ? <i>tortus</i> , Meek & Hayden	-----	-----	-----	*	-----
9. GEN. BACULITES.					
21. <i>Baculites ovatus</i> , Say	-----	-----	-----	*	*
22. <i>Baculites compressus</i> , Say	-----	-----	-----	*	*
23. <i>Baculites grandis</i> , Hall & Meek	-----	-----	-----	-----	*
10. GEN. SCAPHITES.					
24. <i>Scaphites Conradi</i> , Morton, Sp.	-----	-----	-----	-----	*
25. <i>Scaphites Mandenensis</i> , Morton, Sp.	-----	-----	-----	-----	*
26. <i>S. Nicolletti</i> , Morton, Sp.	-----	-----	-----	*	*
27. <i>S. nodosus</i> , Owen	-----	-----	-----	*	-----
28. <i>S. larviformis</i> , Meek & Hayden	-----	*	-----	*	-----
11. GEN. SCALARIA.					
29. <i>S. cerithiformis</i> , Meek & Hayden	-----	-----	-----	-----	*
12. GEN. TURRITELLA.					
30. <i>T. ? convexa</i> , Meek & Hayden	-----	-----	-----	*	-----
31. <i>T. Moreauensis</i> , Meek & Hayden	-----	-----	-----	-----	*
13. GEN. ACTEON.					
32. <i>A. concinnus</i> , Hall & Meek	-----	-----	-----	*	*
33. <i>A. subellipticus</i> , Meek & Hayden	-----	-----	-----	*	-----
34. <i>A. (Solidula) attenuata</i> , Meek & Hayden	-----	-----	-----	*	*
14. GEN. AVALANA.					
35. <i>A. subglobosa</i> , Meek & Hayden	-----	-----	-----	-----	*
15. GEN. NATICA.					
36. <i>N. Tuomyana</i> , Meek & Hayden	*	-----	-----	-----	-----
37. <i>N. obliquata</i> , Hall & Meek	-----	-----	-----	*	-----
38. <i>N. coccinea</i> , Hall & Meek	-----	-----	-----	*	-----
39. <i>N. paludinaformis</i> , Hall & Meek	-----	-----	-----	*	-----
40. <i>N. umbigua</i> , Meek & Hayden	-----	-----	-----	-----	*

TABLE—Continued.

	Formations in ascending order.				
	1	2	3	4	5
15. GEN. NATICA—Continued.					
41. <i>N. subcrassa</i> , Meek & Hayden.....	*				
42. <i>N. occidentalis</i> , Meek & Hayden.....					o
43. <i>N. Moreauensis</i> , Meek & Hayden.....					o
16. GEN. SOLARIUM.					
44. <i>S. flexuistriatum</i> , Evans & Shumard.....				*	
17. GEN. TURBO.					
45. <i>T. Nebrascensis</i> , Meek & Hayden.....				*	
46. <i>T. tenuilineatus</i> , Meek & Hayden.....				*	
18. GEN. ROSTELLARIA.					
47. <i>R. Nebrascensis</i> , Evans and Shumard.....				*	
48. <i>R. fusiformis</i> , Hall & Meek.....				*	
49. <i>R. biangulata</i> , Meek & Hayden.....				*	
19. GEN. FUSUS.					
50. <i>F. Shumardi</i> , Hall & Meek.....				*	
51. <i>F. tenuilineatus</i> , Hall & Meek.....				*	
52. <i>F. Dakotaensis</i> , Meek & Hayden.....					o
53. <i>F. Galpinianus</i> , Meek & Hayden.....					o
54. <i>F. contortus</i> , Meek & Hayden.....					o
55. <i>F. Culbertsoni</i> , Meek & Hayden.....					o
56. <i>F. flexuocostatus</i> , Meek & Hayden.....					o
57. <i>F. Newberryi</i> , Meek & Hayden.....					o
58. <i>F. Vaughani</i> , Meek & Hayden.....					o
59. <i>F. subturritus</i> , Meek and Hayden.....				*	
60. <i>F. intertextus</i> , Meek & Hayden.....				*	
61. <i>F. (Pleurotoma) Scarboroughi</i> , Meek & Hayden.....					o
20. GEN. BUSTYCON.					
62. <i>B. Bairdi</i> , Meek & Hayden.....					o
21. GEN. FASCIOLARIA.					
63. <i>F. cretacea</i> , Meek & Hayden.....					o
64. <i>F. buccinoides</i> , Meek & Hayden.....					o
22. GEN. BUCCINUM.					
65. <i>B. ? vinculum</i> , Hall & Meek.....				*	
66. <i>B. constrictum</i> , Hall & Meek.....				*	
23. NEW GEN. PSEUDOBUCCINUM, Meek & Hayden.					
67. <i>P. Nebrascensis</i> , Meek & Hayden.....					o

TABLE—Continued.

	Formations in ascending order.				
	1	2	3	4	5
24. GEN. CAPULUS, Hall & Meek.					
68. <i>C. occidentalis</i> , Hall & Meek				*	
69. <i>C. fragilis</i> , Meek & Hayden					*
25. GEN. HELCION.					
70. <i>H. borealis</i> , Morton, Sp.				*	
71. <i>H. sexcucatus</i> , Meek & Hayden				*	
72. <i>H. patelliformis</i> , Meek & Hayden				*	
73. <i>H. alveolus</i> , Meek & Hayden				*	
74. <i>H. subovatus</i> , Meek & Hayden				*	
75. <i>H. carinatus</i> , Meek & Hayden				*	
26. GEN. DENTALIUM.					
76. <i>D. gracilis</i> , Hall & Meek				*	
77. <i>D. fragilis</i> , Meek & Hayden				*	
27. GEN. BULLA.					
78. <i>B. volvaria</i> , Meek & Hayden					*
79. <i>B. minor</i> , Meek & Hayden					*
80. <i>B. occidentalis</i> , Meek & Hayden				*	
81. <i>B. subcylindricus</i> , Meek & Hayden				*	
28. GEN. XYLOPHAGA.					
82. <i>X. elegantula</i> , Meek & Hayden				*	
83. <i>X. Stimpsoni</i> , Meek & Hayden				*	
29. GEN. PHOLAS.					
84. <i>P. cuneata</i> , Meek & Hayden					*
30. GEN. TEREDO.					
85. <i>T. globosa</i> , Meek & Hayden					*
31. GEN. SOLEN.					
86. <i>S. ? Dakotaensis</i> , Meek & Hayden	*				
32. GEN. PHOLODOMYA.					
87. <i>P. elegantula</i> , Evans & Shumard				*	
88. <i>P. (Gonomya) Americana</i> , Meek & Hayden					*
89. <i>P. undata</i> , Meek & Hayden	*				
90. <i>P. fibrosa</i> , Meek & Hayden				*	
91. <i>P. subventricosus</i> , Meek & Hayden	*				
33. GEN. PANOPEA.					
92. <i>P. occidentalis</i> , Meek & Hayden	*				

TABLE—Continued.

	Formations in ascending order.				
	1	2	3	4	5
34. GEN. SOLEMYA.					
93. <i>S. subplicata</i> , Meek & Hayden					○
35. GEN. MACTRA.					
94. <i>M. formosa</i> , Meek & Hayden	○				
95. <i>M. Warrenana</i> , Meek & Hayden					○
96. <i>M. alta</i> , Meek & Hayden	○				
36. GEN. TELLINA.					
97. <i>T. ? cheyennensis</i> , Meek & Hayden	○?				
98. <i>T. equilateralis</i> , Meek & Hayden				○	
99. <i>T. scitula</i> , Meek & Hayden					○
100. <i>T. subelliptica</i> , Meek & Hayden					○
101. <i>T. Proui</i> , Meek & Hayden				○	
102. <i>T. subtortuosa</i> , Meek & Hayden	○				
37. GEN. CYTHEREA.					
103. <i>C. Missouriiana</i> , Morton				○	
104. <i>C. orbiculata</i> , Hall & Meek		○			
105. <i>C. tenuis</i> , Hall & Meek		○			
106. <i>C. Deweyi</i> , Meek & Hayden					○
107. <i>C. Nebrascensis</i> , Meek & Hayden					○
108. <i>C. pellucida</i> , Meek & Hayden				○	
109. <i>C. Owenana</i> , Meek & Hayden	○				
38. GEN. VENUS.					
110. <i>V. ? circularis</i> , Meek & Hayden				○	
39. GEN. LEDA.					
111. <i>L. ventricosa</i> , Meek & Hayden					○
112. <i>L. Moreauensis</i> , Meek & Hayden					○
40. NEW GEN. CORBULAMELLA, Meek & Hayden.					
113. <i>C. gregaria</i> , Meek & Hayden				○	
41. GEN. THRACIA.					
114. <i>T. ? gracilis</i> , Meek & Hayden	○				
42. GEN. ASTARTE.					
115. <i>A. gregaria</i> , Meek & Hayden					○
43. GEN. CRASSATELLA.					
116. <i>C. Evansi</i> , Hall & Meek				○	

TABLE—Continued.

	Formations in ascending order.				
	1	2	3	4	5
44. GEN. LUCINA.					
117. <i>L. subundata</i> , Hall & Meek	-----	-----	-----	⊙	-----
118. <i>L. occidentalis</i> , Meek & Hayden	-----	-----	-----	⊙	-----
45. GEN. HETTANGIA.					
119. <i>H. Americana</i> , Meek & Hayden	⊙	-----	-----	-----	-----
46. GEN. CYPRINA.					
120. <i>C. arenaria</i> , Meek & Hayden	⊙	-----	-----	-----	-----
121. <i>C. cordata</i> , Meek & Hayden	-----	-----	-----	-----	⊙
122. <i>C. compressa</i> , Meek & Hayden	-----	-----	-----	-----	⊙
123. <i>C. ovata</i> , Meek & Hayden	-----	-----	-----	-----	⊙
124. <i>C. subumida</i> , Meek & Hayden	-----	-----	-----	⊙	⊙
47. GEN. CARDIUM.					
125. <i>C. Speciosum</i> , Meek & Hayden	⊙	-----	-----	-----	-----
48. GEN. NUCULA.					
126. <i>N. subnasuta</i> , Hall & Meek	-----	-----	-----	⊙	-----
127. <i>N. ventricosa</i> , Hall & Meek	-----	-----	-----	⊙	-----
128. <i>N. scitula</i> , Meek & Hayden	-----	-----	-----	-----	⊙
129. <i>N. Evansi</i> , Meek & Hayden	-----	-----	-----	-----	⊙
130. <i>N. equilateralis</i> , Meek & Hayden	-----	-----	-----	-----	⊙
131. <i>N. subplana</i> , Meek & Hayden	-----	-----	-----	⊙	-----
132. <i>N. cancellata</i> , Meek & Hayden	-----	-----	-----	-----	⊙
133. <i>N. planomarginata</i> , Meek & Hayden	-----	-----	-----	-----	⊙
134. <i>N. obsoletastrata</i> , Meek & Hayden	-----	-----	-----	⊙	-----
49. GEN. PECTUNCULUS.					
135. <i>P. parvula</i> , Meek & Hayden	-----	-----	-----	-----	⊙
136. <i>P. subimbricatus</i> , Meek & Hayden	-----	-----	-----	-----	⊙
50. GEN. CUCULLEA.					
137. <i>C. Nebrascensis</i> , Owen	-----	-----	-----	-----	⊙
138. <i>C. cordata</i> , Meek & Hayden	-----	-----	-----	-----	⊙
139. <i>C. Shumardi</i> , Meek & Hayden	-----	-----	-----	-----	⊙
140. <i>C. exigua</i> , Meek & Hayden	-----	-----	-----	⊙	-----
51. GEN. MYTILUS.					
141. <i>M. attenuatus</i> , Meek & Hayden	-----	-----	-----	-----	⊙
142. <i>M. Galpinianus</i> , Evans & Shumard	-----	-----	-----	-----	⊙
143. <i>M. subarcuatus</i> , Meek & Hayden	⊙	-----	-----	-----	-----
52. GEN. AVICULA.					
144. <i>A. triangularis</i> , Evans & Shumard	-----	-----	-----	⊙	-----
145. <i>A. linguiformus</i> , Evans & Shumard	-----	-----	-----	⊙	-----
146. <i>A. Haydeni</i> , Hall & Meek	-----	-----	-----	⊙	-----

TABLE—Continued.

	Formations in ascending order.				
	1	2	3	4	5
53. GEN. GERVILIA.					
147. <i>G. subtortuosa</i> , Meek & Hayden				*	
54. GEN. INOCERAMUS.					
148. <i>I. problematicus</i> , Schlotheim			*		
149. <i>I. Barabini</i> , Morton				*	
150. <i>I. Sagensis</i> , Owen				*	
151. <i>I. Nebrascensis</i> , Owen				*	
152. <i>I. subleavis</i> , Hall & Meek				*	
153. <i>I. convexus</i> , Hall & Meek				*	
154. <i>I. tenilineatus</i> , Hall & Meek				*	
155. <i>I. Conradi</i> , Hall & Meek		*			
156. <i>I. fragilis</i> , Hall & Meek		*			
157. <i>I. ventricosus</i> , Meek & Hayden	*				
158. <i>I. pertenuis</i> , Meek & Hayden	*				
159. <i>I. incurvus</i> , Meek & Hayden				*	
160. <i>I. umbonatus</i> , Meek & Hayden				*	
55. GEN. PECTEN.					
161. <i>P. rigida</i> , Hall & Meek				*	
162. <i>P. Nebrascensis</i> , Meek & Hayden				*	*
56. GEN. OSTREA.					
163. <i>Ostrea congesta</i> , Conrad			*		
164. <i>Ostrea larva</i> , Lamark				*	
165. <i>Ostrea patina</i> , Meek & Hayden				*	
166. <i>Ostrea glabra</i> , Meek & Hayden	*				
57. GEN. CAPRINELLA.					
167. <i>Caprinella coralloidea</i> , Hall & Meek				*	
58. GEN. LINGULA.					
168. <i>Lingula subspatulata</i> , Hall & Meek				*	
59. GEN. SERPULA.					
169. <i>Serpula? tenuicarinata</i> , Meek & Hayden		*			
60. GEN. HEMIASTER.					
170. <i>Hemiaster? Humphreysianus</i> , Meek & Hayden				*	
61. VERTEBRATA.					
171. <i>Mosagarus Missouriensis</i> , Leidy				*	

There are still in the collection several undescribed species of mollusca, also remains of fishes from Nos. 2, 3, and 4.

The great lignite tertiary basin differs from the tertiary basin of White river, by its numerous beds of lignite, more or less pure, and by the extent and beauty of its fossil flora. Some of the beds of lignite are seven feet in thickness, but they usually vary from two to four feet. The collection of fossil plants from this deposit is very fine, consisting of nearly fifty species, all of which are as yet undescribed, but are supposed to be new to science. Many of the leaves strongly resemble those of existing forest trees, and seem to belong to the genera *Platanus*, *Acer*, *Ulmus*, *Alnus*, *Populus*, *Betula*, *Shulex*, &c. The mollusca consist of land and fresh water, with a few estuary shells. These have all been described, and drawings made. Five species of vertebrata have been discovered in this deposit. The following species of organic remains have, up to this time, been described from this basin.

VERTEBRATA.

1. *Thespesius occidentalis*, Leidy.
2. *Ischyrotherium antiquum*, Leidy.
3. *Mylognathus priscus*, Leidy.
4. *Compsemys victus*, Leidy.
5. *Emys obscurus*, Leidy.

MOLLUSCA.

6. *Cyclas formosa*, Meek and Hayden.
7. *Cyclas fragilis*, Meek and Hayden.
8. *Cyclas subellipticus*, Meek and Hayden.
9. *Cyrena moreauensis*, Meek and Hayden.
10. *Cyrena intermedia*, Meek and Hayden.
11. *Corbula mactrififormis*, Meek and Hayden.
12. *Unio priscus*, Meek and Hayden.
13. *Bulimus teres*, Meek and Hayden.
14. *Bulimus vermiculus*, Meek and Hayden.
15. *Bulimus limneaformis*, Meek and Hayden.
16. *Bulimus Nebrascensis*, Meek and Hayden.
17. *Pupa helicoides*, Meek and Hayden.
18. *Limnea tenuicosta*, Meek and Hayden.
19. *Physa longiuscula*, Meek and Hayden.
20. *Physa rhomboidea*, Meek and Hayden.
21. *Physa Nebrascensis*, Meek and Hayden.
22. *Planorbis subumbilicatus*, Meek and Hayden.
23. *Planorbis convolutus*, Meek and Hayden.
24. *Planorbis fragilis*, Meek and Hayden.
25. *Velletia (Ancylus) minuta*, Meek and Hayden.
26. *Paludina multi lineata*, Meek and Hayden.
27. *Paludina Leai*, Meek and Hayden.
28. *Paludina retusa*, Meek and Hayden.
29. *Paludina peculiaris*, Meek and Hayden.
30. *Paludina trochiformis*, Meek and Hayden.
31. *Paludina Leidy*, Meek and Hayden.

32. *Valvata parvula*, Meek and Hayden.
33. *Melania minutula*, Meek and Hayden.
34. *Melania Anthonyi*, Meek and Hayden.
35. *Melania multistriata*, Meek and Hayden.
36. *Melania Nebrascensis*, Meek and Hayden.
37. *Melania Warrenana*, Meek and Hayden.
38. *Melania tenui carinata*, Meek and Hayden.
39. *Cerithium Nebrascensis*, Meek and Hayden.

The tertiary basin of White and Niobrara rivers forms one of the most interesting and remarkable fresh water deposits on our continent. It differs, both lithologically and paleontologically, from the two basins previously alluded to. It contains no fossil plants, no lignite beds, and not one of the numerous species of organic remains which have been collected from it is identical or allied to species found in other portions of the tertiary of the northwest. Two distinct faunas are represented by the collections from this deposit. The fauna of the miocene period from the region of White river, and the fauna of the pliocene period from the Niobrara. The latter fauna has enabled Dr. Leidy, the distinguished comparative anatomist, to arrive at some important conclusions. He says:

“The extinct fauna of the Niobrara is especially rich in remains of ruminating and equine animals. Among the former are several peculiar genera, of which two are closely allied to *Oreodon* and *Leptauchenia*, of the miocene deposit of the Mauvaises Terres; one is allied to the musk-deer and another closely approaches the camel. Besides the remains of a true species of *Equus*, the collection contains those of two species of *Hipparion*, and several peculiar genera of the equine family. There are also remains of several species of canine and feline animals, of a small species of beaver, and of a species of porcupine more nearly allied to that of the old world than to our own recent one. The collection further contains remains of a rhinoceros, resembling those of India, those of a new species of mastodon, and those of a large elephant.

“One of the most remarkable circumstances in relation with this extinct fauna is, that it is more nearly allied to the present recent one of the old world than to that of our own continent. From a comparison of our recent fauna and flora with that of the eastern continent, the deduction has been made, that the western continent is the older of the two, geologically speaking, whereas, the Niobrara fauna would indicate just the reverse relationship of age. A number of similar instances show that totally different fauna and flora may be cotemporaneous, and do not necessarily indicate different period of existence.”

Vertical section, showing the order of superposition of the different beds of the Tertiary basin of White and Niobrara rivers.

SUBDIVISIONS.		LOCALITIES.	Estimated thickness.
POST PLEISTOCENE.		Most fully developed along the Missouri river, from the mouth of the Niobrara to St. Joseph; also in the Platte valley and on the Loup Fork.	300 to 500 feet.
PLIOCENE TERTIARY.	Bed F.	Covers a very large area on Loup Fork, from the mouth of North Branch to source of Loup Fork; also in the Platte valley. Most fully developed on the Niobrara river, extending from the mouth of Turtle river three hundred miles up the Niobrara. Also on Bijoux Hills and Medicine Hills. Thinly represented in the valley of White river.	300 to 400 feet.
MIOCENE.	Bed E.	Usually a coarse grained sandstone, sometimes heavy bedded and compact; sometimes loose and incoherent; varies much in different localities. Forms immense masses of conglomerate; also contains layers of tabular limestone with indistinct organic remains; very few mammalian remains detected, and those in a fragmentary condition. Passes gradually into the bed below.	180 to 200 feet.
	Bed D.	Niobrara and Platte rivers; well developed in the region of Fort Laramie; also in the valley of White river. Conspicuous, and composing the main part of the dividing ridge between White and Niobrara rivers.	350 to 400 feet.

VERTICAL SECTION—Continued.

	SUBDIVISIONS.		LOCALITIES.	Estimated thickness.
MIOCENE.	Bed C.	Very fine yellow calcareous sand, not differing very materially from Bed D, with numerous layers of concretions and rarely organic remains, passing down into a variegated bed, consisting of alternate layers of dark brown clay and light grey calcareous grit, forming bands, of which I counted twenty-seven at one locality, varying from one inch to two feet in thickness.	White river, Bear creek, Ash Grove spring, head of Shyenne river. Most conspicuous near White river.	50 to 80 feet.
	Turtle and Oredon Bed B.	A deep flesh colored argillo-calcareous indurated grit; the outside, when weathered, has the appearance of a plastic clay. Passes down into a gray clay, with layers of sandstone; underlaid by a flesh colored argillo-calcareous stratum, containing a profusion of mammalian and chelonian remains. Turtle and Oredon Bed.	Old Woman's creek, a fork of Shyenne river; also on the head of the South Fork of the Shyenne; most conspicuous on Sage and Bear creeks, and at Ash Grove spring. Well developed in numerous localities in the valley of White river.	80 to 100 feet.
	Titanotherium Bed A.	Light gray fine sand, with more or less calcareous matter, passing down into an ash-colored plastic clay, with large quantities of quartz grains disseminated through it, sometimes forming aggregated masses like quartzose sandstone cemented with plastic clay; then an ash-colored clay with a greenish tinge, underlaid at base by a light gray and ferruginous silicious sand and gravel, with pinkish bands. Immense quantities of silex in the form of seams all through the beds. Titanotherium Bed.	Old Woman's creek; also in many localities along the valley of the South Fork of Shyenne. Best development on Sage and Bear creeks. Seen at several localities in the valley of White river.	80 to 100 feet.
CRETACEOUS.	Nos. 4 and 5.	Cretaceous beds 5 and 4, with their usual lithological characters and fossils.	Exposed underneath the tertiary beds on the South Fork of Shyenne and its southern branches, also in White river valley near its source.	

Catalogue of all the fossils hitherto described, from the tertiary formations of White and Niobrara rivers, with a table showing their stratigraphical position.

	Beds in ascending order.					
	A.	B.	C.	D.	E.	F.
RUMINANTIA.						
1. <i>Oreodon gracilis</i> , Leidy		*	*	*		
2. <i>Oreodon Culbertsoni</i> , Leidy		*	*	*		
3. <i>Oreodon major</i> , Leidy		*		*		
4. <i>Agriochærus major</i> , Leidy		*		*		
5. <i>Agriochærus antiquus</i> , Leidy		*		*		
6. <i>Poebrotherium Wilsoni</i> , Leidy		*		*		
7. <i>Leptomeryx Evansi</i> , Leidy		*		*		
8. <i>Leptauchenia decora</i> , Leidy				*		
9. <i>Leptauchenia major</i> , Leidy				*		
10. <i>Protomeryx Halli</i> , Leidy				*		
11. <i>Merycodus necatus</i> , Leidy						*
12. <i>Megalomeryx niobrahensis</i> , Leidy						*
13. <i>Merychochærus proprius</i> , Leidy				*		
14. <i>Procamelus occidentalis</i> , Leidy						*
15. <i>Procamelus robustus</i> , Leidy						*
16. <i>Procamelus gracilis</i> , Leidy						*
17. <i>Merychys elegans</i> , Leidy						*
18. <i>Merychys medius</i> , Leidy						*
19. <i>Merychys major</i> , Leidy						*
20. <i>Cervus Warreni</i> , Leidy						*
MULTUNGULA.						
21. <i>Chæropotamus (Hypotamus) americanus</i> , Leidy	*					
22. <i>Entelodon Mortoni</i> , Leidy		*		*		
23. <i>Entelodon ingens</i> , Leidy		*		*		
24. <i>Titanotherium Prouti</i> , Leidy	*					
26. <i>Paleochærus probus</i> , Leidy		*		*		
27. <i>Leptochærus spectabilis</i> , Leidy		*		*		
28. <i>Rhinoceros occidentalis</i> , Leidy		*	*	*	*	
29. <i>Rhinoceros (Hyracodon) nebrascensis</i> , Leidy		*	*	*	*	
30. <i>Rhinoceros crassus</i> , Leidy						*
31. <i>Mastodon (Tetralophodon) merificus</i> , Leidy						*
32. <i>Elephas (Euelephas) imperator</i> , Leidy						*
SOLIDUNGULA.						
33. <i>Hipparion, S. Hippotherium occidentale</i> , Leidy						*
34. <i>Hipparion, S. Hippotherium speciosum</i> , Leidy						*
35. <i>Anchitherium Bairdi</i> , Leidy		*				
36. <i>Anchitherium (Hyphippus) affinis</i> , Leidy				*		
37. <i>Anchitherium (Parahippus) cognatus</i> , Leidy				*		
38. <i>Merychippus insignis</i> , Leidy						*
39. <i>Merychippus mirabilis</i> , Leidy						*
40. <i>Equus excelsus</i> , Leidy						*
41. <i>Equus (Protohippus) perditus</i> , Leidy						*
RODENTIA.						
42. <i>Steneofiber nebrascensis</i> , Leidy			*	*		
43. <i>Ischyromys typus</i> , Leidy			*	*		

CATALOGUE—Continued.

	Beds in ascending order.					
	A.	B.	C.	D.	E.	F.
RODENTIA—Continued.						
44. <i>Palæolagus Haydeni</i> , Leidy	-----	-----	o	o	-----	-----
45. <i>Eumys elegans</i> , Leidy	-----	o	-----	-----	-----	-----
46. <i>Hystrix (Hystriopsis) venustus</i> , Leidy	-----	-----	-----	o	-----	o
47. <i>Castor (Eucastor) tortus</i> , Leidy	-----	-----	-----	-----	-----	o
CARNIVORA.						
48. <i>Hyænodon horridus</i> , Leidy	-----	o	-----	-----	-----	-----
49. <i>Hyænodon cruentus</i> , Leidy	-----	o	-----	-----	-----	-----
50. <i>Hyænodon crucians</i> , Leidy	-----	o	-----	-----	-----	-----
51. <i>Amphicyon vetus</i> , Leidy	-----	o	-----	-----	-----	-----
52. <i>Amphicyon gracilis</i> , Leidy	-----	o	-----	-----	-----	-----
53. <i>Leptacrus primus</i> , Leidy	-----	-----	-----	-----	-----	o
54. <i>Deinictis felina</i> , Leidy	-----	o	-----	-----	-----	-----
55. <i>Machairodus primævus</i> , Leidy	-----	o	-----	-----	-----	-----
56. <i>Felis (Pseudalurus) intrepidus</i> , Leidy	-----	-----	-----	-----	-----	o
57. <i>Ælurodon ferox</i> , Leidy	-----	-----	-----	-----	-----	*
58. <i>Canis sævus</i> , Leidy	-----	-----	-----	-----	-----	o
59. <i>Canis temerarius</i> , Leidy	-----	-----	-----	-----	-----	o
60. <i>Canis vafer</i> , Leidy	-----	-----	-----	-----	-----	o
61. <i>Canis (Epicyon) Haydeni</i> , Leidy	-----	-----	-----	-----	-----	o
CHELONIA.						
62. <i>Testudo nebrascensis</i> , Leidy	-----	o	o	o	o	-----
63. <i>Testudo (Stylernys) niobrahensis</i> , Leidy	-----	-----	-----	-----	-----	o
MOLLUSCA.						
64. <i>Helix Leidyi</i> , Hall and Meek	-----	o	-----	-----	-----	-----
65. <i>Planorbis nebrascensis</i> , Evans and Shumard	-----	-----	-----	o	-----	-----
66. <i>Lymnea diaphana</i> , Evans and Shumard	-----	-----	-----	o	-----	-----
67. <i>Lymnea nebrascensis</i> , Evans and Shumard	-----	-----	-----	o	-----	-----
68. <i>Physa scalaria</i> , Evans and Shumard	-----	-----	-----	o	-----	-----
CRUSTACEA.						
69. <i>Cypris Leidyi</i> , Evans and Shumard	-----	-----	-----	o	-----	-----

MINERALS AND GEOLOGICAL SPECIMENS.

I. IGNEOUS AND METAMORPHIC ROCKS.

1	Gneiss ferruginous	12 miles northwest of Fort Laramie
2	Mica slate	do
3	Mica, more micaceous	do
4	Granite, coarse	Laramie peak
5	Mica slate, with silvery mica	4 miles north of Fort Laramie
6	Granite, pulverulent	Raw Hide butte
7	Felspar, flesh-colored from No. 6	do
8	Granite, fine grained, micaceous	do
9	Granite, gray	Laramie hills
10	Quartz, white	do
11	Hornblende slate	do
12	Hornblende rock	do
13	Mica slate	do
14	Hornblende rock in granite	do
15	Red felspar from 14	do
16	Crystalline quartz from 14	do
17	Flesh-colored felspar from 14	do
18	Mica slate, with garnets	do
19	Mica slate, with garnets	do
20	Mica, containing iron	do
21	Flesh-colored felspar in large crystals	do
22	Chlorite slate	do
23	Mica slate	do
24	Granite, coarse, over No. 23	do
25	Felspathic granite, pink	do
26	Quartz veins in 25	do
27	Hornblende rock, masses in granite	do
28	Granite, fine grained	do
29	Hornblende rock	do
30	Hornblende granite	do
31	Hornblende, with crystals of felspar	do
32	Mica slate, hornblende	do
33	Mica slate, hornblende	do
34	Mica slate, with large plates of mica	do
35	Granite, white felspathic	do
36	Quartz, veins in 35	do
37	Silicious limestone, silurian or devonian	do
38	do	do
39	do	do
39½	Syenite, pink, under 39	do
40	Metamorphic silicious limestone	Raw Hide butte
41	do	do
42	Quartz, in granite	do
43	Metamorphic limestone, gray	do
44	Mica slate	do
45	Micaceous granite	do
46	do	do
47	Mica slate, fine grained	do
48	Metamorphic limestone, crystalline	do
49	do	do
50	do	do
51	Talcose slate	do
52	Felspathic granite, flesh-colored	do
53	Mica slate, with garnets	do
54	do	do
55	Talcose slate, dark	do
56	do	do
57	Porphyritic trap	Black hills

Minerals and geological specimens—Continued.

58	Hornblende slate	Black hills
59	Felspathic granite, pink	do
60	Plates of mica from 59	do
61	Quartz vein in chlorite slate	do
62	Chlorite slate	do
63	Trachyte	do
64	Quartz veins in 63	do
65	do	do
66	Chlorite slate	Raw Hide butte, west side
67	Hornblende rock, underlying tertiary series	do
68	Schorn in quartz from clay slate	Black hills
69	do	do
70	Augite	do
71	Quartz, with felspar	Laramie hills
72	Porphyritic trap, columnar	Stone butte, Black hills
73	do	do
74	do	do
75	Trachyte	do
76	Vesicular trap	do
77	Trachyte	do
78	Silicious limestone	Raw Hide butte
79	Porphyritic trachyte	Stone butte, Black hills
80	Compact trachyte, with scales of mica	Bear peak, Black hills
81	do	do
82	Gray basaltic trap	do
83	Porphyritic trachyte	do
84	do	do
85	Quartzite	do
86	Gray trachyte	do
87	Metamorphic sandstone	do

II. SEDIMENTARY ROCKS.

Silurian and devonian.

89	Potsdam sandstone, red, with <i>Lingula antiqua</i>	do
90	do	do
91	do	do
92	Metamorphic, conglomerate over granite	Laramie hills
93	do	do
94	do	do
95	Argillaceous limestone, devonian	do
96	Metamorphic conglomerate	do

Carboniferous.

97	Limestone, with spirifer	Black hills
98	Blue cherty limestone, with <i>Spirigera subtilita</i>	do
99	do	do
100	do	do
101	<i>Rhynchonella mormoni</i>	do
102	do	do
103	do	do
104	do	do
105	do	do
106	Yellowish do. over 98, with <i>Spirifer rockymontana</i>	do
107	do	do
108	Cherty nodules in 98	do
109	<i>Aragonia</i> in 98	do
110	Coarse, granular limestone, with crinoidal columns	Fort Laramie

111	Blue, compact, limestone, <i>Productus</i> and <i>Terebratula subtilita</i>	Fort Laramie
112	.....do.....do.....do.....corals .....	.....do.....
113	.....do.....do.....do.....with <i>Spirifer lineatus</i> .....	.....do.....
114	Yellowish cherty limestone, with <i>Productus</i>	Warm spring near Fort Laramie..
115	White limestone, with <i>Spirifer rocky montana</i>	Near Fort Laramie.....
116	<i>Terebratula subtilita</i> from 110 .....	.....
117	<i>Panopaea</i>	Near Tecama, Nebraska
118	<i>Allorisma</i>	Bellevue, Nebraska
119	<i>Productus</i> .....	.....do.....
120	<i>Spirifer cameratus</i> .....	.....do.....
121	<i>Terebratula subtilita</i> .....	.....do.....
122	<i>Bellerophon</i> .....	.....do.....
123	<i>Chonetes</i> .....	.....do.....
124	<i>Chaetetes</i> .....	.....do.....
<i>Permian-carboniferous and permian.</i>		
125	Arenaceous limestone, foliated with <i>bakevella</i>	Black hills
126	Red sandstone, soft, very fine grain, under 125.....	.....do.....
127	Pink sandstone, over 126 .....	.....do.....
128	Limestone, (125,) with <i>Orthoceras</i> .....	.....do.....
129	.....do.....with <i>Bellerophon</i> .....	.....do.....
130	.....do.....with <i>Pleurotomaria</i> .....	.....do.....
131	.....do.....with <i>Spirifer</i> .....	.....do.....
132	.....do.....with <i>Allorisma</i>	Big Blue, Kansas Territory
133	Yellow magnesian limestone, with <i>Nautilus</i> , <i>Monotis</i> , <i>Bakevella</i> , <i>Myalina</i>	Smoky Hill fork
134	.....do.....compact, with <i>Mytilus</i>	Banks of Mo., south line of Neb..
135	Magnesian limestone, with <i>Monotis</i>	Big Cottonwood
136	.....do.....with <i>Avicula</i>	12 miles west Big Blue
137	Chert rock, gray, with <i>Avicula</i> and <i>Myalina</i>	Black hills
138	.....do.....(Burch stone,) with crinoidal columns .....	.....do.....
139	Saccharoid gypsum, over 133.....	Smoky Hill fork.....
140	<i>Monotis</i> from 136 .....	.....do.....
141	Blue limestone, porous, with fenestella	Big Blue.....
142	Cellular calcareous rock	Smoky Hill fork.....
143	.....do.....do.....more compact .....	.....do.....
144	.....do.....do.....with spherical cavities .....	.....do.....
145	.....do.....do.....more argillaceous	Near Cottonwood creek.....
<i>Jurassic.</i>		
146	Arenaceous limestone, light brown, with <i>Avicula tenuicostata</i>	Black hills
147	.....do.....bluish, over 146, with <i>Avicula</i> .....	.....do.....
148	Ferruginous limestone, with <i>Cypricardia</i> .....	.....do.....
149	.....do.....red, with <i>Avicula</i> .....	.....do.....
150	Yellow arenaceous limestone, with <i>Serpula</i> .....	.....do.....
151	Limestone bored, with lithophagous mollusks .....	.....do.....
152	Red marl, overlying 141, containing snowy gypsum .....	.....do.....
153	Snowy gypsum from 152 .....	.....do.....
154	Crystalline gypsum from seams in 152 .....	.....do.....
155	Fibrous gypsum.....do.....do.....	.....do.....
156	Blue compact limestone, (fresh water,) in 153, containing <i>Unio mucalis</i> and <i>Planorbis</i> .....	.....do.....
157	Arenaceous limestone, same as 150, containing pentacrinus, with <i>Serpula</i> and <i>Ostrea</i> attached to surfaces.....	.....do.....
158	Yellowish argillo-arenaceous limestone, with <i>Ostrea</i> , Upper Jurassic .....	.....do.....
159	Gray shell limestone, containing <i>Ammonites</i> , <i>Belemnites</i> , &c., interstratified with 153 .....	.....do.....

160	Snowy gypsum, with no stains, equivalent of 153..	Big Horn river
161	Gypsum, with crystals of selenite	
162	Snowy gypsum	Near sources of Yellowstone
CRETACEOUS.		
Formation No. 1.		
163	Conglomerate and sandstone, with <i>Unios</i>	Bad lands of Judith
164	Conglomerate	do
165	do fine, with <i>Melania</i> and <i>Cyclas</i>	do
166	Gray arenaceous limestone, with <i>Melania</i> and <i>helix</i>	do
167	Conglomerate, same as 165	do
168	Arenaceous limestone, (166,) with leaves of <i>cred-</i> <i>neria</i> , <i>melanias</i> , &c	do
169	Indurated ferruginous clay, with <i>melanias</i>	do
170	Ferruginous sand, with <i>unio danai</i>	do
171	Indurated clay, with <i>Melania</i> and scales of <i>Lepido-</i> <i>tus</i> above 166	do
172	Shell limestone containing <i>Melania</i>	do
173	Impure sandy lignite (stratum D of section)	do
174	Shell limestone, same as 172	do
175	Cream colored shale, burnt from over lignite beds	do
176	Compact argillaceous limestone, with <i>Cytherea owenii</i> (marine,) beneath fresh water beds	do
177	Ferruginous sandstone, with <i>Tellina subtortuosa</i>	do
178	Rough, gray, limestone, with <i>Ostrea glabra</i>	do
179	Ferruginous sandstone, with <i>Inoceramus pedunculis</i> , upper marine strata	do
180	Lignite, over 179	do
181	Carbonaceous sand from decomposition of lignite bed over 179	Rocky Mountain creek
182	Impure shaly lignite, with selenite	Near Ammel's island
183	Limestone, with <i>Cypris</i> , lower part of formation No. 1	Black hills, east base
184	Silicified wood, ferruginous	do do
185	do coniferous	do do
186	Bone of saurian	do do
187	do or cetacian	do do
188	Dense ferruginous sandstone	Black hills, west base
189	Quartzose sandstone, bluish	do do
190	do	
191	Conglomerate from junction of cretaceous and carboniferous rocks	Platte valley
192	Coarse ferruginous sandstone, with pebbles, over 199	do
193	Dark ferruginous sandstone over 192	do
194	do containing much iron	do
195	do do do	do
196	Ferruginous sandstone	Blackbird hill
197	do fine grained	Mouth of Elk horn
198	Dark, coarse, sandstone, very ferruginous	do
199	Red, ferruginous sandstone, with many species of dicotyledonous leaves	Black hills
200	do do	
201	Light gray quartzose sandstone, with balls of sul- phate of iron over 199	Black hills
202	do with dicotyledonous leaves	do
203	Whitish puerulent sandstone over 199	Sioux City
204	do fine grained under 199	Blackbird hill
205	Indurated clay, bluish	do
206	do yellow	Decatur

Minerals and geological specimens—Continued.

207	Indurated clay, yellow	Decatur
208	Ferruginous sandstone, with striated bivalves and <i>Cytherea arenaria</i>	Big Sioux
209	Indurated clay, with dicotyledonous leaves	do
210	do sand, fine, yellow, with leaves of salix	do
211	Ferruginous sandstone	Mouth of Iowa creek
212	do do fine grained, with im- pressions of dicotyledonous leaves	Mouth Big Sioux
213	do do with <i>Solen dacotahensis</i>	do
214	Lignite under 209	do
215	Silicified wood, bored by teredo	Big Sioux
216	do do	Blackbird hills
217	do do	Smoky Hill fork
218	do do	Republican fork
219	Coarse, ferruginous sandstone, with leaves of <i>Credneria</i>	Smoky hill
220	Sandstone, very ferruginous	do
221	Cellular, ferruginous, rock	do
Formation No. 2.		
222	Masses sulphuret iron, with sulphate	Mouth of Vermillion
223	Crystallized do do	do
224	do gypsum	do
225	do do	do
226	do in plates	do
227	Large crystals selenite in black clay	do
228	do do do	do
229	Ferruginous shale, with remains of fishes	do
230	do shell limestone	do
231	Yellow clay, with gypsum	do
232	Conglomerate, with green silicious pebbles	do
233	do with shark's teeth	do
234	Gray arenaceous limestone, with <i>Cytherea orbiculata</i>	do
235	do do with fish scales	do
236	Dark gray indurated clay, with fish scales	Black hills, east base
237	Arenaceous limestone, (234,) with <i>Serpula</i>	Dixon's bluffs
238	Conglomerate, with fish teeth	do
239	Arenaceous limestone, gray, with <i>Inoceramus proble-</i> <i>maticus</i>	Black hills, west base
Formation No. 3.		
240	Soft, yellow, limestone, with <i>Inoceramus problematicus</i>	Big Sioux
241	Gray marl, with <i>Ostrea congesta</i> , and fish remains (base of No. 3)	Mouth James river
242	do do	do
243	Scale of <i>Cycloladus</i> in 242	do
244	Fibrous carbonate of lime, with <i>Ostrea congesta</i> at- tached to surface	Durions hills
245	Yellow marl	do
246	do	Bijoux hills
247	do lighter	do
248	Crystalline carbonate of lime, seams in marl	do
249	do greenish in marl	do
250	Black plastic clay, upper part of No. 3	Near Bijoux hills
251	Shale, argillaceous, with fish remains over 250	do
252	do calcined by combustion of 250	do
Formation No. 4.		
253	Blue clay, with <i>Ptychoceras mortoni</i>	Great bend of Missouri

254	Yellow clay, with crystals of gypsum	Great bend of Missouri
255	Whitish alum clay, seams in 253	Bijoux hills
256	Hyd. silicate of magnesia, masses in formation No. 4	do
257	Crystals sulphate baryta	do
258	White aluminous earth in seams	do
259	Aluminous clay (255)	do
260	Ferruginous concretions throughout F, No. 4	do
261	Crystalline argillaceous limestone (Cone in cone)	Shyenne river
262	Crystals of selenite in clay beds	Fort Pierre
263	Selenite and fibrous carbonate lime	Mouth Shyenne
264	Yellow clay, with selenite	12 miles above Fort Pierre
265	Dark, argillaceous, shale, with <i>Inoceramus</i>	Mouth of Cannon Ball river
266	Blue concretionary limestone, with <i>Rostellaria</i>	Long Lake, Missouri
267	Indurated clay	do
268	Decomposed shale (253)	Fort Pierre
269	Brown hematite	Big Shyenne
270	do more earthy	do
271	Dog tooth spar	Mussel Shell river
272	Gray arenaceous limestone	Milk river
273	do with carbonized matter, and shells	Cannon Ball river
274	Soft argillaceous shale	Yellow Stone river
275	Concretions of compact blue limestone, contain- ing great numbers of fossils	do
276	do containing large crustacean (un- described)	do
277	Crystallized carbonate of lime, yellow, forming nucleus of concretions	Forks of Shyenne
278	Crystals of selenite	do
279	Blue indurated clay, with fibrous gypsum	do
280	Dove colored laminated shale	Grand river
281	Petrified wood bored by <i>Teredo bisinuata</i>	
282	"Cone in cone" (241)	Cannon Ball river
283	Indurated clay, with shells	Grand river
284	Soft micaceous sandstone, thin seam in clay bed	Fort Pierre
285	Vertebra of <i>Mososaurus</i>	do
286	Wood bored by <i>Zylophaga stimpsoni</i>	Mussel shell river
287	White aluminous clay	Fort Lookout

Formation No. 5.

288	Yellow arenaceous limestone, with <i>Venus</i>	Head of Little Missouri
289	do softer	do
290	Yellowish calcareous sandstone, with <i>Cyprina</i>	Cannon Ball river
291	do do decomposed	do
292	Soft, fine, sandstone, with <i>Rostellaria</i>	do
293	Ferruginous sandstone, with <i>Cytherea</i>	do
294	Silicified wood, with bark	Long Lake
295	do bored by <i>Teredo globosa</i>	do

TERTIARY.

A. lignite basin.

296	Yellow arenaceous clay on cetaceous rocks	
297	Yellowish indurated clay, with fresh water shells over 296	Long Lake
298	Gray sand, fine, over 297	do
299	Coarse, gray, calcareous sandstone, with fossils	Top of Square butte
300	Soft argillo-calcareous shale, with fossil shells	Thunder Butte
301	Ferruginous shale, with coniferous plants	do
302	Dove colored sandstone, with silicified wood	do

303	Yellow indurated sand, with estuary shell of genus, <i>Cyrena</i>	Cherry creek
304	Light colored indurated clay, base of section	Fort Clark
305	Dark carbonaceous clay, over 304	do
306	Lignite, over 305	do
307	Dark argillaceous shale, over 306	do
308	Yellow indurated sand, with <i>Paludina</i> and <i>Melania</i>	do
309	Grayish indurated sand	do
310	Dove colored calcareous shale, with <i>Unios</i> and other fresh water shells	Red spring
311	Argillaceous limestone, with fossil plants	Fort Berthold
312	Fine light colored marl, under lignite bed	do
313	Lignite, bright and compact	do
314	Drab indurated clay	High butte, Little Missouri
315	Light colored marl, with impressions of dicotyledonous leaves	Fort Union
316	Earthy lignite	do
317	Lignite	Yellowstone
318	do more impure	do
319	Concretions sulphuret iron, common throughout tertiary series	do
320	Septaria, spherical	Fort Union
321	Carbonaceous indurated clay, charged with vegetable remains, fresh water, and land shells, <i>Bulimus</i> , <i>Physa</i> , <i>Pupa</i> , &c	do
322	Mineralized wood	do
323	Carbonized wood from lignite bed	do
324	Light sandy marl	do
325	Shell marl, containing fresh water shells	do
326	Impure lignite	do
327	Light colored, fine, clay, under lignite bed	do
328	Brown shale, with vegetable impressions	Milk river
329	Silicious shale, containing much vegetable matter	do
330	Gray shell limestone, soft	do
331	Carbonaceous clay, with <i>Unio</i> , <i>Paludina</i> , &c	Yellowstone
332	Coarse, gray shell, limestone	Elk Horn prairie
333	Compact, bluish, limestone, with fresh water shells	Red spring
334	Gray calcareous sandstone, with <i>Unio</i> , <i>Paludina</i> , &c	Yellowstone
335	Soft argillaceous limestone, with <i>Paludina rochiiformis</i>	Pardu river
336	Crystallized carbonate of lime in concretions	Fort Union
337	Dove colored argillaceous limestone, with impressions of ferns, over 315	do
338	Brown calcareous shale, with <i>Tuzites</i>	Yellowstone
339	Silicified wood	do
340	do partially carbonized	do
341	do do do	do
342	do do do	do
343	do do do	do
344	do do with cavities lined with drusy quartz	Fort Union
345	Dove colored clay, metamorphosed by burning out of lignite beds	Mussel Shell river
346	Brownish shale	do
347	Scoria, black, formed by	Yellowstone
348	do yellowish	do
349	do black compact	do
350	do green vitreous	do
351	do do	do
352	do red, very porous	do
353	do brown, very porous	do
354	Shale burned red, with vegetable impressions	do
355	do bright red	do
356	do vermillion, with gypsum	do

Minerals and geological specimens—Continued.

356	Shale, burned, black ferruginous	Yellowstone
357	Calcareous pumice from burning of limestone	do
B. WHITE RIVER BASIN.		
Bed A.		
358	Red, sandy, clay, containing pebbles, base of <i>Titanotherium</i> bed	On Shyenne river
359	Teeth of <i>Titanotherium prouti</i>	Old Woman's fork
360	Coarse, whitish, sandstone, above 358	Shyenne river
361	do..... concretionary	do
362	Soft, whitish, calcareous sandstone, with scales of mica	do
363	Greenish plastic clay	do
364	do..... upper part	Sage creek
365	Plates of chalcedony	Bear creek
366	do.....	do
367	do.....	do
368	Fibrous carbonate lime	do
369	Dark chalcedony	do
370	Magnesite	do
371	Calcareous concretion separating bed <i>a</i> from bed <i>b</i>	do
Bed B.		
372	Pinkish, indurated, marl	do
373	Whitish.....do..... from over 372	do
374	Pinkish calcareous concretion	do
375	Decomposed marl from 372 and 373	do
376	do.....do..... with <i>Oreodon</i>	do
Bed D.		
377	Cream colored marl	White river
378	Silicious limestone, with fresh water shells, <i>Planorbis</i> , <i>Limnea</i> , &c	do
379	Tufaceous, concretionary, limestone	do
380	Cream colored marl, containing <i>Oreodon</i>	do
Bed E.		
381	Soft, white, grit	do
382	Conglomerate, above 381	do
383	do..... with granitic pebbles	do
384	Soft, white, sandstone, with <i>Oreodon</i>	do
385	Calcareous conglomerate	Fort Laramie
386	Conglomerate	Bijoux hills
387	Calcareous concretions in marl, under 386	do
388	Sulphate baryta foliated crystals in 387	do
389	Green silicious concretions in limestone, containing fresh water shells	Medicine hills
390	do.....do.....do.....	do
391	Coarse, whitish, sandstone	Bad Land creek
392	Conglomerate	Grand Stone hill
393	Quartzose conglomerate	do
394	White infusorial earth, base of bed <i>e</i> , local	Running Water
395	do.....do.....do.....	Loup fork
396	do.....	do
397	Indurated marl, white	Warren's fork
398	Silicious tufa	Niobrara river
399	White marl	Loup fork

400	Whitish cherty limestone.....	do.....
401	White foliated limestone.....	Niobrara river.....
402	.....	.....
403	White tufaceous marl, containing fresh water shells	Loup Fork.....
404	Silicified wood.....	Running Water.....
405	do.....	do.....
406	Siliceous sinter.....	Sage creek.....
407	Carbonate of lime.....	Bear Peak.....
408	Ferruginous conglomerate.....	Yellowstone river.....
409	Micaceous granite.....	do.....
410	Hornblendic rock.....	do.....
411	Limestone, with corals.....	do.....
412	do.... with <i>Spirifer</i>	do.....
413	do.... with <i>Orthoceras</i>	do.....
414	do.... with <i>Syringopora</i>	do.....
415	Chalcedony.....	do.....
416	Silicified wood.....	do.....
417	Limestone, with red chert.....	do.....
418	Concretions from yellow marl.....	Big Sioux.....
419	Siliceous sinter from springs.....	Black Hills.....
420	Sand from sand hills.....	do.....
421	Very fine, gray, sand from sand dune.....	Powder river.....
422	Prismatic iron ore.....	Mouth Big Horn.....
423	Efflorescence on soil.....	Cannon Ball river.....

Dr. Newbery rendered me valuable assistance in making out the preceding catalogue.

MAMMALS.

The mammals of the collection have already been examined by Professor Baird, and most of the species determined. The collection contains skins, skeletons, and skulls of nearly all the larger mammals of the plains, with a large number of specimens of most of the smaller ones. I will here say a few words in regard to the present distribution of some of the larger animals on the upper Missouri. Many of them are fast passing away, and in a few years must become extinct. The buffalo, which has been so important an agent in the preservation of the Indians, is now gradually gathering into a smaller area, and although in the valley of the Yellowstone and along the upper Missouri thousands may yet be seen, they are annually decreasing at a rapid rate. In 1850 buffaloes were seen as low down on the Missouri as the Vermilion river, and in 1854 a few were killed near Fort Pierre, but at the present time none, except now and then a stray bull, are seen on the Missouri river below Fort Clark.* They are, however, quite abundant at this time on the Platte river and along the valley of the Smoky Hill Fork of the Kansas. Probably at this time all the larger animals, as buffalo, elk, deer, antelope, bighorn, and beaver, are more abundant in the valley of the Yellowstone than in any other portion of the upper Missouri.

Descending the Yellowstone river in the summer of 1854 I saw, for the distance of 350 miles, the prairies on both sides of the river covered with herds of buffalo, and on the sand bars large numbers of elk, deer, and antelopes. Elk and white-tailed deer (*Cervus leucurus*) are quite abundant even in the northern parts of Iowa, but the black-tailed deer (*Cervus macrotis*) is seldom seen below Fort Pierre. It is found chiefly in the most rugged portions of the country, in the region of the Black Hills or in the vicinity of the mountains. The interminable ravines of Sage creek and the Shyenne river are noted places for them. The antelope is seldom observed below Fort Pierre. It is, however, the most abundant animal in the Sioux country, and confined to the open prairies. The bighorn, or mountain sheep, (*Ovis montana*,) is quite abundant in the almost inaccessible regions known as the Mauvais Terres or Bad Lands, but are not hunted much by the Indians for food. The beaver are increasing very rapidly, and many of the mountain streams literally swarm with them. Since the days of the trapper are over, and the prices of their fur has become so reduced, the inducements to hunt them are not very great, and they are allowed to multiply undisturbed. Their flesh is eaten to some extent by the Indians and traders, and in the absence of other meat is considered quite a delicacy. The raccoon is seldom seen beyond the frontier. A few have been killed in the valley of White river, but they seldom pass up the Missouri above latitude 42°. The following is a list of the mammals contained in the collection and now deposited in the Smithsonian Institution :

* These animals occupy very different localities in different years and different seasons.—
Lieutenant Warren.

1. *Sorex Haydeni*, Baird, (n. s.)—Hayden's Shrew.—Fort Pierre to Fort Union, Nebraska Range on the Missouri river, from latitude 44.20 to 48.00.—This small species of shrew is quite rare in Nebraska. It is seldom seen alive, though sometimes found dead along river banks. A single specimen was caught at Fort Pierre in the autumn of 1856, and a second one at Fort Union, near the mouth of the Yellowstone. Three specimens were secured.

2. *Blarina brevicauda*, Gray.—Short-tailed Shrew.—Illinois to Nebraska.—A single specimen of this species was obtained near Fort Berthold, on the Missouri, in lat. , lon. ; very rare.

3. *Scalops argentatus*, Aud. & Bach.—Silvery Mole.—Detroit to Fort Riley, and south to Prairie Mer Rouge? Range in lat. from 42.20 to Louisiana? in long. 83 to 97.—One specimen of this beautiful species was collected near the mouth of Big Sioux river. I do not think it occurs high up on the Missouri river.

4. *Lynx rufus*, Raf.—Wild Cat.—Atlantic to Pacific. Upper Missouri to the Gila river. Not on the Rio Grande?—The skins of this animal are very often brought to the different trading posts on the upper Missouri by the Indians, though seldom seen by the traveller. There is no portion of the country bordering on the Missouri river, or its tributaries, where it does not exist to a greater or less extent. The Canada Lynx, (*Lynx canadensis*,) has also been observed in several localities by the traders of the country.

5. *Canis occidentalis* var. *griseo-albus*.—White and Gray Wolf.—North America generally? *Canis occidentalis* var. *nubilus*.—Dusky Wolf.—Missouri river to the Pacific.—This species with its numerous varieties, is exceedingly abundant throughout the region of the upper Missouri, above latitude 43°. It is most abundant where the buffalo range, and subsists mostly upon them. Their skins are made an article of trade, being valued at one dollar a piece.

6. *Canis latrans*, Say.—Coyote; Prairie Wolf.—Fort Riley, Kansas, to the Pacific, and upper Missouri to the Rio Grande of Texas.—This animal is much smaller, and the skins sell for only half the price of the *C. occidentalis*. It is exceedingly abundant throughout the upper Missouri country, extending down into the settlements, where they often do much mischief to the farmers.

7. *Vulpes macrourus*, Baird.—Prairie Fox.—Upper Missouri to Plains of Columbia, O. T.—This is much the finest animal of the genus in this country. The skins are remarkable for the thickness and beauty of their fur. The different varieties, as silver, cross, and black fox, are well known among the traders, and are much valued. A skin of the silver variety is a great prize, often selling for a hundred dollars.

8. *Vulpes velox*, Aud. & Bach.—Kit Fox; Swift Fox.—Plains west of Missouri to the Cascade mountains of Oregon.—Like the prairie or barking wolf this animal is fond of wandering down among the settlements and committing his depredations upon the farmers. It is much hunted by the traders; but its skin is not very valuable, averaging only about twenty-five cents per skin. It is very abundant around prairie dog villages, and subsists to a great extent upon the inhabitants.

9. *Putorius longicauda*, Rich.—Long-tailed Weasel.—Upper Missouri and Platte. (Carlton House, H. B. T. Rich.)—Not uncommon throughout the northwest, though seldom seen by the traveller. Its skin is highly prized by the Indians, who use it for making articles of dress, tobacco pouches, and for other ornamental purposes.

10. *Lutra canadensis*, Sab.—American Otter.—Northern parts of the United States to Florida, and west to the Rocky mountains.—Not uncommon in the streams that flow from the north into the Missouri. I cannot ascertain that it has been seen above the mouth of the Niobrara river on the Missouri. The only specimen obtained by our party was taken in a beaver trap in the Niobrara, about eighty miles above its mouth. Otter skins are imported into the country every year by the traders, and are prized very highly by the Indians for ornamental purposes.

11. *Mephitis mephitis*.—Common Skunk.—United States, east of the Missouri plains and north of Texas.—Very common throughout the upper Missouri country.

12. *Taxidea americana*, Waterh.—Missouri Badger.—Iowa and Wisconsin to the Pacific coast, and from Arkansas to 49 N. lat.—(To 58 N. lat., Rich.)—This animal is not rare, though not very abundant on the Missouri. It seems to be of very little economical value, except for food to the starving Indian.

13. *Procyon lotor*, Storr.—Common Raccoon.—Massachusetts to Florida, and west to Fort Kearney. Not in southern Texas?—Very abundant in the vicinity of Council Bluffs, where the skin is made a considerable article of trade with the Indians. It is not found high up on the Missouri. The highest point that I have observed it was near the mouth of the Niobrara river, though I have been informed that they are sometimes seen in the valley of White river.

14. *Ursus horribilis*, Ord.—Grizzly Bear.—Plains of upper Missouri to the Rocky mountains, and along their base, thence to the coast of California, (not of Oregon or Washington?)—This formidable animal is still quite abundant toward the sources of the Missouri. At the present time it is very seldom, if ever, seen below Fort Pierre. But one skin was taken by our party.

15. *Sciurus ludovicianus*, Custis.—Western Fox Squirrel.—Mississippi valley.—Very abundant about Council Bluffs. Gradually becomes rare, and ceases near the mouth of White river.

16. *Sciurus carolinensis*, Gm.—Gray Squirrel; Black Squirrel.—Eastern United States to the Missouri river.—Two specimens of this squirrel were taken, one near Fort Leavenworth, and the other near the mouth of the Platte. It is seldom, if ever, seen above this point.

17. *Sciurus fremontii*, Towns.—Mountain Gray Squirrel.—A specimen obtained at Laramie Peak is supposed to belong to this species.

18. *Sciurus hudsonius*, Pallas.—Red Squirrel; Chickaree.—Labrador (lat. 56°) to Mississippi; and in the United States from the Atlantic to the Missouri river.—Several specimens supposed to be identical with this species were collected in the Black Hills, and is quite abundant in the oak woods of that region.

19. *Tamias quadrivittatus*, Rich.—Missouri Striped Squirrel.—Upper Missouri to Rocky mountains, and west to the Cascade Range.

Along the Rocky mountains as far south as Fort Staunton, New Mexico. Lat. $33^{\circ} 30'$.—Very common in the "Bad Lands" and rocky portions of the upper Missouri. Seldom, perhaps never, seen below Fort Pierre.

20. *Spermophilus franklini*, Rich.—Gray Gopher.—Northern Illinois and Wisconsin, and to Minnesota and Saskatchewan.—One specimen of the above species was taken near the mouth of the Loup Fork of the Platte. Quite rare.

21. *Spermophilus tridecem-lineatus*, Aud. & Bach.—Striped Gopher; Prairie Squirrel.—Eastern Michigan to the plains of the Missouri, and south to Red river, Arkansas, and Fort Thorn, N. M.—Very abundant on all the prairies of the northwest.

22. *Spermophilus Townsendii*, Bachman.—Townsend's spermophile. Rocky mountains to the north. Several specimens were collected near Fort Laramie.

23. *Cynomys ludovicianus*.—Prairie Dog.—Milk river and upper Missouri; west towards the Rocky mountains; south to Red river; southwest to the Upper Rio Grande, and a short distance into Sonora?—Very abundant from the mouth of the Niobrara to the mountains; found in great numbers in the valley of the Yellowstone and along the Missouri, above Fort Union.

24. *Arctomys flaviventer*, Bachman.—Yellow-footed Marmot.—Black Hills, Neb.—This animal is very rare, but one specimen having been secured on the upper Missouri. The skins of only two individuals are in the museum of the Smithsonian Institution.

25. *Castor canadensis*, Kuhl.—American Beaver.—Throughout the entire area of North America.—The history of this animal is more interesting than that of any other on the upper Missouri. In the palmy days of the trapper the beaver became very scarce in the west; but since the price of their fur has become so low as to render the business of trapping them an unprofitable pursuit, they have multiplied to an enormous extent, so that all the little streams flowing from the mountains literally swarm with them. Their skins, however, are still a considerable article of trade.

26. *Geomys bursarius*, Lich.—Pouched or Pocket Gopher.—Missouri to Minnesota and Nebraska.—Very abundant on the rich bottoms around Council Bluffs and Big Sioux, where they do much mischief in the gardens. One specimen was taken near the mouth of Big Sioux, and a second on the Niobrara.

27. *Thomomys rufescens*, Maxim.—Fort Union Gopher.—Fort Pierre to Fort Union, on the Missouri.—This gopher seems to take the place of the *Geomys bursarius* from Fort Pierre to the mountains. Two specimens were collected at Fort Union, and one at Fort Randall, on the Missouri.

28. *Jaculus hudsonius*.—Jumping Mouse.—Nova Scotia, (Labrador, Pennant,) to southern Pennsylvania, and west to the Pacific ocean.—Very rare. Only two specimens were obtained near Fort Union.

29. *Perognathus flavus*, Baird.—Upper Missouri, along eastern slopes of Rocky mountains to Sonora and Chihuahua; and along the Rio Grande to Matamoras.—Collected on the Loup Fork during the summer of 1857.

30. *Dipodomys ordii*, Woodhouse.—Kangaroo Rat.—Platte river, along the eastern slope of the Rocky mountains, into Durango and Coahuila, Mexico.—A single specimen was taken on the Niobrara river.

31. *Mus musculus*, Linn.—Common Mouse.—North America generally. (Introduced.)—Abundant at all the fur trading posts on the Missouri. *Mus rattus* or common rat is also introduced.

32. *Hesperomys sonoriensis*, Leconte.—Upper Missouri, and Rocky mountains to El Paso and Sonora.—Very abundant near Fort Union and along the Yellowstone. Twenty-five specimens collected.

33. *Hesperomys leucogaster*.—Missouri Mouse.—Plains along the upper Missouri.—Very rare; but two specimens secured; one near Bijox Hills, the other on Vermilion prairie, and are the only specimens in the museum of the Smithsonian Institution.

34. *Neotoma cinerea*.—Rocky Mountain Rat.—Eastern slope of northern Rocky mountains and upper Missouri.—Not rare, but seldom captured; usually found among the dry trees on the river bottoms. The only specimen secured was taken at Fort Sarpy, near the mouth of the Big Horn river, on the Yellowstone.

35. *Arvicola Haydeni*, Baird, (n. s.).—Fort Pierre, Nebraska.—But one specimen of this species has ever been detected.

36. *Lepus campestris*, Bach.—Prairie Hare.—Upper Missouri and Saskatchewan plains to the Cascade Range of Oregon.—This hare, though not extremely abundant, is not uncommon in the northwest, from the mouth of Niobrara river to the mountains. Four specimens were collected on the Yellowstone.

37. *Lepus sylvaticus*, Bach.—Gray Rabbit.—From Massachusetts throughout the United States, as far as Indianola, Texas? and west to the Missouri, as far as Fort Union, Nebraska.—Found all along the Missouri river to the mountains, but mostly confined to the wooded bottoms of the rivers and streams. Eight specimens are in the collection of the expedition.

38. *Lepus artemisia*, Bach.—Sage Hare.—Regions west of the Missouri to the Rocky mountains, and to the Cascade mountains of Oregon, along the Columbia on the north, and to the city of Chihuahua on the south.—Abundant in the Bad Lands and on the Sage plains of the upper Missouri river. Five specimens were obtained by the expedition.

39. *Cervus canadensis*, Erxl.—American Elk.—Northern portions of United States to upper Missouri, and west to the Pacific. Found in the Alleghenies of Pennsylvania and Virginia. (North to 57°, Rich.)—Most abundant in the valley of the Yellowstone and along the Missouri river above Fort Union. Not rare, though less abundant as low down the Missouri as Council Bluffs. The collection contains two pairs of skins, two of skeletons, with numerous separate skulls, and about twenty pairs of antlers.

40. *Cervus leucurus*, Douglass.—White-tailed Deer.—Upper Missouri and Platte to the Columbia river and Washington Territory. Western Texas and New Mexico?—Very abundant along the river bottoms; most common from Council Bluffs to Fort Pierre. Four skins, with numerous separate skins and antlers, were obtained.

41. *Cervus macrotis*, Say.—Mule Deer.—Upper Missouri and Platte to the Cascade Range, (head of Des Chutes river.) Oregon Territory. Not extending to the Pacific. Headwaters of Arkansas.—Much more abundant on the upper Missouri than the *Cervus leucurus*. Four skins, two skeletons, and about thirty separate skulls and horns, were collected.

42. *Antilocapra americana*, Ord.—Prong-horn Antelope; Cabree.—Plains west of Missouri, from the lower Rio Grande to the Saskatchewan, and west to the Cascade and coast range of the Pacific slope.—This beautiful and fleet animal is found everywhere on the open grassy plains, from the mouth of the Niobrara river to the mountains. Our collection contains eight skins entire, one skeleton, and a large number of skulls.

43. *Ovis montana*, Cuvier.—Bighorn; Mountain Sheep.—Broken ground on the upper Missouri and Platte. Rocky mountains generally, as far west, at least, as Coast and Cascade mountains of the Pacific slope.—Very abundant in the rugged and inaccessible portions of the upper Missouri, especially the "Bad Lands."

44. *Bos americanus*, Gmelin.—American Buffalo.—Formerly found throughout nearly the whole of North America, east of the Rocky mountains. Now confined to the plains west of the Missouri and along the slopes of the Rocky mountains.

45. *Vespertilio pruinus*, Say.—All over the United States east of the Rocky mountains.

46. *Vespertilio noctivagans*, Leconte.—Common throughout the country east of the Rocky mountains.

47. *Vespertilio novaboracensis*, Gmelin.

BIRDS.

	No. of specimens.
1.— <i>Cathartes aura</i> , (Linn.) Illig. Turkey Buzzard. All of North America, except the Arctic regions	1
2.— <i>Falco (Falco) anatum</i> , Bonaparte. Duck Hawk. North America, east of the Rocky mountains	1
3.— <i>Falco (Hypotriorchis) columbarius</i> , Linn. Pigeon Hawk. Temperate North America, Mexico, Central America, Northern South America	2
4.— <i>Falco (Gennaia) polyagrus</i> , Cassin. Prairie Falcon. Western North America	3
5.— <i>Falco (Tinnunculus) sparverius</i> , Linn. Sparrow Hawk. Entire continent of America	5
6.— <i>Accipiter mexicanus</i> , Swains. Western North America	3
7.— <i>Buteo swainsoni</i> , Bonap. Swainson's Buzzard. Northern and Western North America	4
8.— <i>Buteo bairdii</i> , Hoy. Baird's Buzzard. Northern and Western North America	3

	No. of specimens.
9.— <i>Buteo (Poecilopternis) borealis</i> , (Gmelin,) Vieill. Red-tailed Hawk. Eastern North America; fur countries; Cuba, Jamaica.....	3
10.— <i>Archibuteo ferrugineus</i> , (Licht.) Gray. California Squirrel Hawk. Western North America.....	1
11.— <i>Circus hudsonius</i> , (Linn.) Vieillot. Marsh Hawk. All of North America and Cuba.....	4
12.— <i>Bubo virginianus</i> , (Gmelin,) Bon. Great Horned Owl. The whole of North America. Runs into varieties, <i>atlanticus pacificus</i> , <i>arcticus</i> , <i>magellanicus</i>	1
13.— <i>Otus wilsonianus</i> , Lesson. Long-Eared Owl. The whole of temperate North America.....	3
14.— <i>Brachyotus cassinii</i> , Brewer. Short-Eared Owl. The whole of temperate North America; Greenland; Cuba.....	2
15.— <i>Syrnium nebulosum</i> , (Forster,) Gray. Barred Owl. Eastern North America; Fort Tejon, Cal.	1
16.— <i>Athene hypugaea</i> , Bonap. Burrowing Owl. From Mississippi river to the Rocky mountains.....	7
17.— <i>Conurus carolinensis</i> , (Linn.) Kuhl. Parakeet. Southern and southwestern States, as far west as the Missouri	12
18.— <i>Coccygus americanus</i> , (Linn,) Bonap. Yellow-billed Cuckoo. Eastern United States to the Missouri plains.....	6
19.— <i>Coccygus erythrophthalmus</i> , (Wils.) Bon. Black-billed Cuckoo. United States to the Missouri plains.....	6
20.— <i>Picus (Trichopicus) villosus</i> , Linn. Hairy Woodpecker. Northern and western regions; var. <i>major</i> , <i>medius</i> , <i>minor</i>	6
21.— <i>Picus (Trichopicus) pubescens</i> , Linn. Downy Woodpecker. Eastern United States, towards the eastern slope of the Rocky mountains.....	3
22.— <i>Picoides dorsalis</i> , Baird. Striped three-toed Woodpecker. Laramie peak, Rocky mountains.....	1
23.— <i>Sphyrapicus varius</i> , (Linn.) Baird. Yellow-bellied Woodpecker. Atlantic ocean to the eastern slopes of Rocky mountains, Greenland.....	8
24.— <i>Sphyrapicus thyroideus</i> , (Cass.) Baird. Brown-headed Woodpecker. Cascade and coast range of California and Oregon	1
25.— <i>Centurus carolinus</i> , (Linn.) Bon. Red-bellied Woodpecker. North America, from Atlantic coast to the eastern slope of the Rocky mountains.....	3
26.— <i>Melanerpes erythrocephalus</i> , (Linn.) Sw. Red-headed Woodpecker. North America, from the Atlantic to the eastern slope of the Rocky mountains.....	9
27.— <i>Melanerpes torquatus</i> , (Wils.) Bonap. Lewis' Woodpecker. Western America, from Black Hills to Pacific	6

	No. of specimens
28.— <i>Colaptes auratus</i> , (Linn.) Sw. Flicker. Eastern North America to the eastern slopes of the Rocky mountains; Greenland	8
29.— <i>Colaptes mexicanus</i> , Swain. Red-shafted Flicker. Western North America, from the Black Hills to Pacific ..	21
29 ^a .— <i>Colaptes hybridus</i> , Baird. Cross between two preceding. Upper Missouri	
30.— <i>Cheatura pelagica</i> , Stephens. Chimney Swallow. Eastern United States to the slopes of the Rocky mountains; Bijox Hills, O. T.	1
31.— <i>Antrostomus nuttalli</i> , (Aud.) Cassin. Nuttall's Whippoorwill. High Central Plains to the Pacific coast ..	2
32.— <i>Chordeiles popetue</i> , (Vieill.) Baird. Night Hawk. North America generally	5
33.— <i>Ceryle (Megaeryle) alcyon</i> , (Linn.) Boie. Belted Kingfisher. Entire continent of North America.	2
34.— <i>Tyrannus carolinensis</i> , (Linn.) Baird. King Bird. Eastern North America to Rocky mountains	9
35.— <i>Tyrannus verticalis</i> , Say. Arkansas Flycatcher. Western North America, from the High Central Plains to the Pacific	19
36.— <i>Sayornis fuscus</i> , (Gm.) Baird. Pewee. Eastern North America	1
37.— <i>Sayornis sayus</i> , (Bon.) Baird. Say's Flycatcher. Upper Missouri river and Central High Plains westward to the Pacific and south to Mexico	5
38.— <i>Contopus richardsonii</i> , (Sw.) Baird. Short-legged Pewee. High Central Dry Plains to the Pacific; Rio Grande valley southward to Mexico; Labrador	2
39.— <i>Empidonax minimus</i> , Baird. Least Flycatcher. Eastern United States to Fort Bridger	6
40.— <i>Turdus (Turdus) mustelinus</i> , Gm. Wood Thrush. Eastern United States to Missouri	1
41.— <i>Turdus (Turdus) fuscescens</i> , Stephens. Wilson's Thrush. Eastern North America to the Missouri; north to fur countries	1
42.— <i>Turdus (Turdus) swainsonii</i> , Cab. Olive-backed Thrush. Eastern North America to Fort Bridger; south to Mexico and Peru; north to Greenland; accidental in Europe and Siberia	3
43.— <i>Turdus (Turdus) aliciae</i> , Baird. Gray-cheeked Thrush. Mississippi region to the Missouri	4
44.— <i>Turdus (Planesticus) migratorius</i> , Linn. Robin. Continent of North America to Mexico	3
45.— <i>Sialia sialis</i> , (Linn.) Baird. Blue Bird. Eastern North America to west of Missouri river; Fort Laramie	9
46.— <i>Sialia arctica</i> , Sw. Rocky Mountain Blue Bird. Upper Missouri to Rocky mountains range, and south to Mexico; rare on the coast of California	9

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| 47.— <i>Regulus calendula</i> , (Linn.) Licht. Ruby-crowned Wren.
United States, from Atlantic to Pacific..... | 4 |
| 48.— <i>Anthus ludovicianus</i> , (Gm.) Licht. Tit-lark. North
America generally; Greenland; accidental in Europe | 1 |
| 49.— <i>Mniotilta varia</i> , (Linn.) Vieill. Black and White
Creeper. Eastern North America to Missouri river;
south to Guatemala. Var. <i>longirostris</i> , Baird. Flo-
rida | 6 |
| 50.— <i>Parula americana</i> , (Linn.) Bonap. Blue yellow-backed
Warbler. Eastern North America to Missouri river;
south to Guatemala..... | 1 |
| 51.— <i>Geothlypis trichas</i> , (Linn.) Cab. Maryland Yellow-
throat. North America, from Atlantic to Pacific.... | 7 |
| 52.— <i>Icteria longicauda</i> , Lawr. Long-tailed Chat. High
Central Plains of United States to the Pacific; south
into Mexico..... | 12 |
| 53.— <i>Helminthophaga celata</i> . (Say,) Baird. Orange-crowned
Warbler. Mississippi river to the Pacific; south to
northern Mexico..... | 2 |
| 54.— <i>Seiurus aurocapillus</i> , (Linn.) Sw. Golden-crowned
Thrush. Eastern North America to the Missouri.... | 8 |
| 55.— <i>Seiurus noveboracensis</i> , (Gm.) Nutt. Water Thrush.
Eastern United States to the Missouri, and south to
Guatemala, perhaps to Brazil..... | 2 |
| 56.— <i>Dendroica coronata</i> , (Linn.) Gray. Yellow Rump.
Eastern North America to the Missouri plains; strag-
glers seen on Puget's Sound..... | 5 |
| 57.— <i>Dendroica audubonii</i> , (Towns.) Baird. Audubon's
Warbler. Pacific coast of United States to Rocky
mountains; south to Mexico..... | 1 |
| 58.— <i>Dendroica pennsylvanica</i> , (Linn., Baird. Chestnut-
sided Warbler. Eastern United States to the Mis-
souri | 1 |
| 59.— <i>Dendroica striata</i> , (Forster.) Baird. Black Poll War-
bler. Eastern North America to the Missouri high
plains; Cuba; Greenland..... | 7 |
| 60.— <i>Dendroica aestiva</i> , (Gm.) Baird. Yellow Warbler.
United States, from Atlantic to Pacific; south to
Guatemala and West Indies..... | 15 |
| 61.— <i>Dendroica maculosa</i> , (Gm.) Baird. Black and Yellow
Warbler. Eastern United States to the Missouri;
south to Guatemala..... | 1 |
| 62.— <i>Setophaga ruticilla</i> , (Linn.) Sw. Redstart. Eastern
United States to Fort Bridger; West Indies in winter | 7 |
| 63.— <i>Pyrranga ludoviciana</i> , (Wils.) Bon. Louisiana Tanager.
From the Black Hills to the Pacific; south to Mexico. | 2 |
| 64.— <i>Hirundo horreorum</i> , Barton. Barn Swallow. North
America, from Atlantic to Pacific..... | 3 |

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| 65.— <i>Hirundo lunifrons</i> , Say. Cliff Swallow. North America, from Atlantic to Pacific..... | 4 |
| 66.— <i>Cotyle riparia</i> , (Linn.) Boie. Bank Swallow. North America generally..... | 2 |
| 67.— <i>Progne purpurea</i> , (Linn.) Boie. Purple Martin. North America generally..... | 13 |
| 68.— <i>Ampelis cedrorum</i> , (Vieill.) Baird. Cedar Bird. North America generally; south to Guatemala..... | 2 |
| 69.— <i>Myiadestes townsendii</i> , (Aud.) Cab. Townsend's Flycatcher. United States, from Rocky mountains and Black Hills to the Pacific; south to the borders of Mexico..... | 1 |
| 70.— <i>Collyrio borealis</i> , (Bon.) Baird. Great Northern Shrike. Northern regions, from Atlantic to Pacific; in winter south, through most of the United States..... | 1 |
| 71.— <i>Collyrio excubitoroides</i> , (Sw.) Baird. White-rumped Shrike. Missouri plains and fur countries to Pacific coast; eastward into Wisconsin, Illinois, and Michigan (?)..... | 6 |
| 72.— <i>Vireo gilvus</i> , (Vieill.) Bon. Warbling Flycatcher. Atlantic to Pacific coast of United States; var. <i>swainsonii</i> ; Columbia river..... | 6 |
| 73.— <i>Vireo (Lanivireo) solitarius</i> , (Wils.) Vieill. Blue-headed Flycatcher. United States, from Atlantic to the Pacific..... | 2 |
| 74.— <i>Mimus carolinensis</i> , (Linn.) Gray. Cat Bird. Eastern United States to Fort Bridger..... | 3 |
| 75.— <i>Oreoscoptes montanus</i> , (Townsend.) Baird. Mountain Mocking Bird. Rocky mountains, from Fort Bridger south to Mexico; along valley of Gila and Colorado; San Diego, California..... | 1 |
| 76.— <i>Harporhynchus rufus</i> , (Linn.) Cab. Brown Thrush. Eastern North America to Missouri river, and perhaps to High Central Plains, unless replaced by a long-tailed variety, (<i>H. Longicauda</i> .)..... | 6 |
| 77.— <i>Salpinctes obsoletus</i> , (Say.) Cab. Rock Wren. High Central Plains, through the Rocky mountains to the Cascade range, (but not on the Pacific coast?) Fort Tejon..... | 6 |
| 78.— <i>Cistothorus (Telmatoodytes) palustris</i> , (Wils.) Cab. Long-billed Marsh Wren. North America, from Atlantic to Pacific; north to Greenland..... | 2 |
| 79.— <i>Cistothorus (Cistothorus) stellaris</i> , (Licht.) Cab. Short-billed Marsh Wren. Eastern United States to the Loup Fork of Platte..... | 1 |
| 80.— <i>Troglodytes aedon</i> , Vieill. House Wren. Eastern United States to the Missouri, or to the High Central Plains..... | 1 |

- 81.—*Troglodytes parkmanni*, Aud. Parkman's Wren. Western America, from the High Central Plains and upper Missouri to the Pacific 13
- 82.—*Sitta canadensis*, Linn. Red-bellied Nuthatch. North America to the Rocky mountains, probably also to the Pacific..... 3
- 83.—*Polioptila caerulea*, (Linn.) Sclat. Blue-Gray Flycatcher. United States, from Atlantic to Missouri, and on the southern border from the Gulf of Mexico to the Coast mountains of California, south to Guatemala 1
- 84.—*Lophophanes bicolor*, (Linn.) Bon. Tufted Titmouse. Eastern North America to the Missouri river, or else replaced there by a *L. missouriensis*..... 1
- 85.—*Parus septentrionalis*, Harris. Long-tailed Chickadee. Missouri river to the Rocky mountains, or else replaced there by *P. albescens*..... 4
- 86.—*Eremophila cornuta*, (Wils.) Boie. Sky Lark. Everywhere on the prairies and desert plains of North America; Atlantic States in winter. A smaller variety on the western plains..... 12
- 87.—*Carpodacus purpureus*, (Gm.) Gray. Purple Finch. North America, from Atlantic to the High Central Plains..... 1
- 88.—*Chrysomitris tristis*, (Linn.) Bon. Yellow Bird. North America generally..... 5
- 89.—*Chrysomitris pinus*, (Wils.) Bon. Pine Finch. North America, from Atlantic to Pacific..... 2
- 90.—*Curvirostra americana*, Wils. Red Crossbill. North America generally, coming southward in winter. Resident in the mountains of Pennsylvania. Perhaps var. *mexicana* in Rocky mountains..... 2
- 91.—*Curvirostra leucoptera*, (Gm.) Wils. White-winged Crossbill. Northern parts of North America generally 2
- 92.—*Plectrophanes (Centrophanes) ornatus*, Towns. Chestnut-collared Bunting. Plains of the upper Missouri .. 5
- 93.—*Plectrophanes (Centrophanes) melanomus*, Baird. Eastern slope of the Rocky mountains; Mexico, on the table-lands 3
- 94.—*Plectrophanes (Rhynchophanes) maccownii*, Lawr. Eastern slopes of Rocky mountains; from Fort Thorn, N. M., as far east as the Black Hills, north of the Platte 3
- 95.—*Passerculus savanna*, (Wils.) Bon. Savannah Sparrow. Eastern North America to the Missouri plains 5
- 96.—*Poocetes gramineus*, (Gm.) Baird. Grass Finch. United States, from the Atlantic to the Pacific; or else one species to the High Central Plains, and another from this to the Pacific..... 10

- 97.—*Coturniculus passerinus*, (Wils.) Bon. Yellow-winged Sparrow. Eastern United States to the High Central Plains (Loup Fork); also along the valley of Gila and Colorado 12
- 98.—*Coturniculus henslowi*, (Aud.) Bon. Henslow's Bunting. Eastern United States as far north as Washington; westward to the Loup Fork of Platte . . . 1
- 99.—*Chondestes grammaca*, (Say.) Bon. Lark Finch. From Wisconsin and the prairies of Michigan to Pacific coast; south to Texas and Mexico on the plains . . . 19
- 100.—*Zonotrichia leucophrys*, (Forster,) Sw. White-crowned Sparrow. United States, from Atlantic to the Rocky mountains, where they become mixed up with *Z. gambelii*; Greenland 3
- 101.—*Zonotrichia gambelii*, (Nutt.) Gambel. Rocky mountains to the Pacific coast; Fort Bridger 2
- 102.—*Zonotrichia querula*, (Nutt.) Gamb. Harris' Finch. Missouri river, above Fort Leavenworth 2
- 103.—*Zonotrichia albicollis*, (Gm.) Bon. White-throated Sparrow. Eastern United States to the Missouri . . . 13
- 104.—*Junco oregonus*, (Townsend.) Sclat. Oregon Snow Bird. Pacific coast of the United States to the eastern side of the Rocky mountains; stragglers as far east as Fort Leavenworth in winter, and Great Bend of Missouri 2
- 105.—*Junco caniceps*, (Woodh.) Baird. Rocky mountains, from Black Hills to Fort Bridger and San Francisco; mountains of New Mexico 2
- 106.—*Junco hyemalis*, (Linn.) Sclat. Snow Bird. Eastern United States to the Missouri, and as far west as Black Hills 3
- 107.—*Spizella monticola*, (Gm.) Baird. Tree Sparrow. Eastern North America to the Missouri; also on Pole creek and Little Colorado river, New Mexico . . . 2
- 108.—*Spizella pusilla*, (Wils.) Bon. Field Sparrow. Eastern North America to the Missouri river 5
- 109.—*Spizella socialis*, (Wils.) Bon. Chipping Sparrow. North America, from Atlantic to Pacific 2
- 110.—*Spizella pallida*, (Sw.) Bon. Clay-colored Bunting. Upper Missouri river and High Central Plains to the Saskatchewan country 5
- 111.—*Melospiza (Melospiza) melodia*, (Wils.) Baird. Song Sparrow. Eastern United States to the High Central Plains 2
- 112.—*Melospiza (Helospiza) lincolnii*, (Aud.) Baird. Lincoln's Finch. United States, from Atlantic to Pacific, and south through Mexico to Guatemala 9
- 113.—*Melospiza (Helospiza) palustris*, (Wils.) Baird. Swamp Sparrow. Eastern United States, from the Atlantic to the Missouri 1

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| 114.— <i>Calamospiza bicolor</i> , (Townsend.) Bon. Lark Bunting. High Central Plains to the Rocky mountains; southwesterly to valley of Mimbres and Sonora..... | 5 |
| 115.— <i>Euspiza americana</i> , (Gm.) Bon. Black-throated Bunting. United States, from the Atlantic to the border of the High Central Plains..... | 17 |
| 116.— <i>Guiraca (Goniaphea) ludoviciana</i> , (Linn.) Sw. Rose-breasted Grosbeak. Eastern United States to the Missouri plains; south to Guatemala..... | 4 |
| 117.— <i>Guiraca (Goniaphea) melanocephala</i> , Sw. Black-headed Grosbeak. High Central Plains, from Yellowstone to the Pacific; table lands of Mexico..... | 5 |
| 118.— <i>Guiraca caerulea</i> , (Linn.) Sw. Blue Grosbeak. More southern United States, from Atlantic to Pacific; south to Mexico..... | 3 |
| 119.— <i>Cyanospiza amoena</i> , (Say,) Baird. Lazuli Finch. High Central Plains to the Pacific..... | 6 |
| 120.— <i>Cardinalis virginianus</i> , Bonaparte. Red Bird. More southern portions of the United States to the Missouri; probably along valley of Rio Grande to Rocky mountains..... | 1 |
| 121.— <i>Pipilo erythrophthalmus</i> , (Linn.) Vieill. Ground Robin. Eastern United States to the Missouri river..... | 9 |
| 122.— <i>Pipilo arcticus</i> , Sw. High Central Plains of upper Missouri, Yellowstone and Platte; Fort Bridger... | 15 |
| 123.— <i>Pipilo chlorurus</i> , (Townsend.) Baird. Blanding's Finch. Valley of Rio Grande and Gila. Rocky mountains north to the South Pass; south to Mexico..... | 3 |
| 124.— <i>Dolichonyx oryzivorus</i> , (Linn.) Sw. Boblink. Eastern United States to Fort Bridger, Utah..... | 3 |
| 125.— <i>Molothrus pecoris</i> , (Gm.) Sw. Cow Bird. United States, from the Atlantic to California; Fort Bridger.... | 7 |
| 126.— <i>Agelaius phoeniceus</i> , (Linn.) Vieill. Swamp Blackbird. United States, from Atlantic to Pacific..... | 9 |
| 127.— <i>Xanthocephalus icterocephalus</i> , (Bon.) Baird. Yellow-headed Blackbird. Western America, from Texas, Illinois, Wisconsin, and North Red river to California; south into Mexico; Greenland..... | 2 |
| 128.— <i>Sturnella magna</i> , (Linn.) Sw. Meadow Lark. Eastern United States to the High Central Plains; south to Mexico; Cuba?..... | 3 |
| 129.— <i>Sturnella neglecta</i> , Aud. Western Lark. Western America, from High Central Plains to the Pacific; east to Pembina, and perhaps to Wisconsin..... | 22 |
| 130.— <i>Icterus spurius</i> , (Linn.) Bon. Orchard Oriole. United States, from the Atlantic to the High Central Plains; probably throughout Texas; south to Guatemala..... | 12 |

- 131.—*Icterus baltimore*, (Linn.) Daudin. Baltimore Oriole.
From Atlantic coast to the High Central Plains,
and in their borders; south to Guatemala..... 9
- 132.—*Icterus bullockii*, (Sw.) Bon. Bullock's Oriole. High
Central Plains to the Pacific; rare on upper Mis-
souri; south into Mexico 1
- 133.—*Scolecophagus ferrugineus*, (Gm.) Sw. Rusty Blackbird.
From Atlantic coast to the Missouri 1
- 134.—*Scolecophagus cyanocephalus*, (Wagl.) Cab. Brewer's
Blackbird. High Central Plains to the Pacific;
south to Mexico; Pembina, Minnesota 5
- 135.—*Quiscalus versicolor*, (Linn.) Vieill. Crow Blackbird.
Atlantic to High Central Plains; Fort Bridger... 7
- 136.—*Corvus carnivorus*, Bartram. American Raven. Entire
continent of North America; rare east of the Mis-
sissippi 4
- 137.—*Corvus americanus*, Aud. Common Crow. North
America to the Missouri region; also on the coast
of California? (Not found on the High Central
Plains?) 5
- 138.—*Picicorvus columbianus*, (Wils.) Bon. Clark's Crow.
From Rocky mountains to Pacific; east to Fort
Kearney 6
- 139.—*Pica hudsonica*, (Sabine.) Bon. Magpie. Arctic re-
gions of North America; the United States, from
the High Central Plains to the Pacific, north
of California 15
- 140.—*Cyanura macrolophus*, Baird. Long-crested Jay. Cen-
tral line of Rocky mountains to the table lands of
Mexico 2
- 141.—*Perisoreus canadensis*, (Linn.) Bon. Canada Jay.
Northern America into the northern parts of the
United States, from Atlantic to Pacific; further
south in Rocky mountains 9
- 142.—*Ectopistes migratoria*, (Linn.) Sw. Wild Pigeon.
North America to High Central Plains 3
- 143.—*Zenaidura carolinensis*, (Linn.) Bon. Common Dove.
Throughout United States, from Atlantic to Pa-
cific; Cuba 1
- 144.—*Tetrao obscurus*, Say. Dusky Grouse. Black Hills of
Nebraska to Cascade mountains of Oregon and
Washington 6
- 145.—*Centrocercus urophasianus*, (Bon.) Sw. Cock of the
Plains. Sage plains of the northwest 4
- 146.—*Pedioecetes phasianellus*, (Linn.) Baird. Sharp-tailed
Grouse. Northern prairies and plains, from Wis-
consin to Cascades of Oregon and Washington... 5

- 147.—*Cupidonia cupido*, (Linn.) Baird. Prairie Hen. Western prairies and plains, within the limits of the United States, east of the Rocky Mountains; south-east to Calcasieu, Louisiana; east to Pocono mountains; Pennsylvania, Long Island, and eastern coast 3
- 148.—*Ortyx virginianus*, (Linn.) Bon. Partridge; Quail. Eastern United States to the High Central Plains. 1
- 149.—*Grus americanus*, (Linn.) Ord. Whooping Crane. Florida and Texas; stragglers in Mississippi valley 1
- 150.—*Ardea herodias*, Linn. Great Blue Heron. Throughout the entire territory of the United States; West Indies 1
- 151.—*Botaurus lentiginosus*, Steph. Bittern. Entire continent of North America 2
- 152.—*Chanadrius vociferus*, (Linn.) Cassin. Killdeer. North America to the Arctic regions; Mexico; South America 5
- 153.—*Aegialitis (Oxyechus) vociferus*, (Linn.) Cassin. Killdeer. North America to the Arctic regions; Mexico; South America 4
- 154.—*Aegialitis (Oxyechus) montanus*, (Towns.) Cassin. Mountain Plover. Western North America; Fort Bridger and Fort Tejon 5
- 155.—*Aegialitis (Aegialeus) melodus*, (Ord.) Cab. Piping Plover. Eastern coast of North America; Nebraska; Louisiana 5
- 156.—*Recurvirostra americana*, Gm. American Avoset. All of temperate North America; Florida 2
- 157.—*Phalaropus wilsonii*, Sab. Wilson's Phalarope. Entire temperate regions of North America; New Mexico 7
- 158.—*Philohela minor*, (Gm.) Gray. American Woodcock. Eastern North America 1
- 159.—*Gallinago wilsonii*, (Temm.) Bon. English Snipe. Entire temperate regions of North America; California 4
- 160.—*Tringa (Actodromas) wilsonii*, Nuttall. Least Sandpiper. Entire temperate North America 1
- 161.—*Tringa (Actodromas) bonapartii*, Schlegel. North America, east of the Rocky mountains 2
- 162.—*Ereunetes petrificatus*, Ill. Semipalmated Sandpiper. Entire temperate regions of North America; South America; varying much in size 4
- 163.—*Gambetta melanoleuca*, (Gm.) Bon. Tell-tale. Stone Snipe. Entire temperate regions of North America. Mexico 2

- 164.—*Rhyacophilus solitarius*, (Wils.) Bon. Solitary Sandpiper. Entire temperate regions of North America. Mexico..... 6
- 165.—*Tringoides macularius*, (Linn.) Gray. Spotted Sandpiper. Entire temperate North America; Oregon. Accidental in Europe..... 3
- 166.—*Actiturus bartramius*, (Wils.) Bon. Field Plover. Eastern North America; South America. Europe..... 8
- 167.—*Limosa fedoa*, (Linn.) Ord. Entire temperate regions of North America. South America..... 2
- 168.—*Numenius (Phaeopus) borealis*, (Forst.) Latham. Esquimaux Curlew. Eastern and northern North America..... 3
- 169.—*Porzana (Porzana) carolina*, Vieill. Common Rail. Entire temperate regions of North America..... 1
- 170.—*Fulica americana*, Gmelin. Coot. Entire temperate regions of North America..... 2
- 171.—*Cygnus buccinator*, Rich. Trumpeter Swan. Western America, from the Mississippi valley to the Pacific..... 1
- 172.—*Bernicla (Leucoblepharon) canadensis*, (Linn.) Boie. Canada Goose. Whole of North America. Accidental in Europe..... 1
- 173.—*Anas boschas*, Linn. Mallard. Entire continent of North America and greater part of Old World.... 1
- 174.—*Dafla acuta*, (Linn.) Jenyns. Sprig-tail; Pin-tail. Whole of North America and Europe..... 1
- 175.—*Nettion crecca*, (Linn.) Kaup. English Teal. Europe; accidental on the eastern coast of the United States, 2
- 176.—*Querquedula discors*, (Linn.) Steph. Blue-winged Teal. Eastern North America to Rocky mountains. Not yet found on the Pacific coast, nor in Europe. 3
- 177.—*Apatula dypeata*, (Linn.) Boie. Shoveller. Continent of North America; abundant in Europe..... 1
- 178.—*Mareca americana*, (Gm.) Stephens. Baldpate; American Widgeon. Continent of North America; accidental in Europe..... 1
- 179.—*Aix sponsa*, (Linn.) Boie. Summer Duck. Continent of North America..... 5
- 180.—*Erismatura rubida*, (Wils.) Bon. Ruddy Duck. Whole of North America; abundant throughout the interior..... 2
- 181.—*Mergus americanus*, Cass. Sheldrake. Whole of North America..... 1
- 182.—*Lophodytes cucullatus*, (Linn.) Reich. Hooded Merganser. Whole of North America..... 1
- 183.—*Larus delawarensis*, Ord. The Ring-billed Gull. Arctic America; Texas to Labrador; western rivers; northwest coast..... 1

184.— <i>Sterna frenata</i> , Gambel.	The Least Tern.	Texas to Labrador; western rivers.....	3
185.— <i>Hydrochelidon plumbea</i> , (Wils.)	The Short-tailed Tern.	Texas to the New England States; Mississippi rivers and tributaries; fur countries.....	1
186.— <i>Podiceps californicus</i> , Heermann.	California Grebe.	Western North America.....	2

FISHES.

A series of the principal fishes inhabiting the Missouri and its tributaries, were collected and preserved in alcohol, and are now deposited in the museum of the Smithsonian Institution. A portion are still undescribed, and of those already determined, Dr. Girard has very kindly furnished me the following list:

1. *Stizostedion boreus*, Grd. Fort Union, Mo.
2. *Gasterosteus inconstans*, Kirtl. Yellowstone river.
3. *Ambloclon grunniens*, Rafin. Milk river.
4. *Pimelodus olivaceus*, Grd. Yellowstone river.
5. *Noturus flavus*, Rafin. Yellowstone river.
6. *Carpionodes damalis*, Grd. Fort Pierre.
7. *Ptychostomus Haydeni*, Grd. Yellowstone river.
8. *Acomus griseus*, Grd. Platte river.
9. *Acomus lactarius*, Grd. Milk river.
10. *Catostomus Sucklii*, Grd. Milk river.
11. *Pimephales fasciatus*, Grd. Milk river.
12. *Hybognathus argyritis*, Grd. Milk river.
13. *Hybognathus Evansi*, Grd. Fort Pierre.
14. *Argyreus dulcis*, Grd. Sweet water.
15. *Pogonichthys communis*, Grd. Milk river.
16. *Gobio gelidus*, Grd. Milk river.
17. *Leucosomus dissimilis*, Grd. Milk river.
18. *Leucosomus macrocephalus*, Grd. Fort Pierre.
19. *Nocomis nebrascensis*, Grd. Sweet water.
20. *Semotilus speciosus*, Grd. Platte river.
21. *Plargyrus bowmani*, Grd. Sweet water.
22. *Hyodon tergisis*, Lesu. Fort Sarpy, Yellowstone.
23. *Scaphirhynchus platyrhynchus*, Baird. Upper Mo.
24. *Polyodon folium*, Lacep. Fort Pierre.

REPTILES.

A large collection of reptiles was made from all parts of the upper Missouri, and it is probable that the following list represents quite fully that portion of the Nebraska fauna. The species have been

identified by Professor Baird and Mr. R. Kennicott, and the specimens are deposited in the museum of the Smithsonian Institution.

1. *Trionyx*. Yellow-stone river.
2. *Emys elegans*. Yellow-stone river.
3. *Emys*. Mouth Powder river.
4. *Cistudo*. Mouth Powder river.
5. *Crotalus confluentus*, Say. Yellow-stone river.
6. *Crotalophorus tergeminus*, Holb. Yellow-stone river.
7. *Entainia sirtalis*, var. *parietalis*, B. & G. Loup Fork.
8. *Entainia*. Sand Hills.
9. *Nerodia sipedon*, B. & G. Yellow-stone river.
10. *Heterodon nasicus*, B. & G. Sand Hills of Loup Fork.
11. *Pituophis sayi*, B. & G. Sand Hills of Loup Fork.
12. *Amphibolus sayi*. Fort Benton, on Missouri river.
13. *Bascanion flaviventris*. Head of Loup Fork.
14. *Chlorosoma vernalis*. Yellow-stone river.
15. *Scelophorus consobrinus*.
16. *Scelophorus graciosus*.
17. *Holbrookia maculata*.
18. *Holbrookia douglassi*.
19. *Cnemidophorus sexlineatus*.
20. *Plestiodon leptogrammus*.
21. *Plestiodon multivirgatum*.
22. *Plestiodon inornatum*.
23. *Plestiodon septentrionalis*.
24. *Rana halcinea*.
25. *Bufo americanus*.
26. *Bufo cognatus*.
27. *Bufo woodhousi*.
28. *Siredon*.

RECENT MOLLUSCA.

An interesting series of recent fluviatile and land Mollusca were secured during the several expeditions from various portions of the upper Missouri. The fresh water shells were very kindly examined by Mr. Isaac Lea, the celebrated conchologist, of Philadelphia. In some remarks before the Philadelphia Academy in regard to the above collection, and one obtained by Mr. Kennicott from the Red river of the north, Mr. Lea says:

“It is not to be understood that either of these collections, made under adverse circumstances, and at times of great personal danger, should be full representatives of this branch of the fauna of these countries. But they are sufficient to prove that zoological life, so far as represented by molluscs, is nearly, if not quite the same, as that of the Ohio river basin, as well as that of the Missouri river and a part of the lower Mississippi and Red river of the south. The knowledge of a part of the species from these remote districts proves to us the wide spread distribution of the same species, as we find every one of them in the Ohio river at Cincinnati, Marietta, and Pittsburg, and

this is the more remarkable, as the waters of the Red river of the north are embraced in a different system of drainage, flowing as they do into Hudson's bay at about 52° north latitude. Here is seen an immense area of country producing in its waters nearly the same life as regards the molluscs, a fact highly interesting to the zoologist."

To Mr. W. G. Binney were transmitted the land shells, which were examined by him with great care. I quote the following remarks from his letter: "These shells are all of value, as they form the first contribution to our knowledge of the species found in those regions. They are, however, for the most part alluvial. *Succinea Haydeni* is the only perfectly fresh species, the animal being preserved in alcohol."

"*Helix costata* was found in myriads, probably the contribution of many small streams above. Of the previously known species it is the most interesting, having been noticed previously in few localities and small numbers. If any argument were needed to establish the point of *H. minuta* (Say) being identical with the European *H. pulchella* (Mull.) it might be found in the fact of the ribbed variety being also found in this country."

The following catalogue comprises all the freshwater and land shells known to us on the upper Missouri:

FLUVIATILE SHELLS.

1. *Unio alatus*, Say. Big Sioux river.
2. *Unio levississimus*, Lea. Big Sioux river.
3. *Unio luteolus*, Lam. " "
4. *Unio asperimus*, Lea. " "
5. *Unio rectus*, Lea. " "
6. *Unio elegans*, Lea. James river.
7. *Unio zizzag*, Lea. White Earth river.
8. *Unio anadontoides*, Lea. James river.
9. *Magaritana complanata*, Lea. Fort Clark, in Missouri.
10. *Anadonta Ferussaciana*, Lea. White river, Nebraska.
11. *Lymnea elodes*, Say. Mouth Big Sioux river.
12. *Lymnea nuttalliana*, Lea. " "
13. *Lymnea humilis*, Say. " "
14. *Lymnea Haydeni*, Lea. " "
15. *Lymnea Kirtlandiana*, Lea. " "
16. *Lymnea umbrosa*, Say. Grindstone creek, Nebraska Territory.
17. *Lymnea lubricoides*, Lea. " "
18. *Lymnea Philadelphica*, Lea. " "
19. *Planorbis bicarinatus*, Say. Mouth Big Sioux river.
20. *Planorbis trivolvus*, Say. " "
21. *Planorbis lentus*, Say. " "
22. *Planorbis parvus*, Say. " "
23. *Planorbis campanulatus*, Say. " "
24. *Physa heterostropha*. " "
25. *Physa integra*? Hald. " "
26. *Physa elongata*, Say. " "
27. *Physa ampularia*, Say. " "

28. *Psidium*—? Grindstone creek.
 29. *Cyclas*—? " "
 30. *Daphnia*—? " "
 31. *Amnicola porata*, Say. Fort Berthold.
 32. *Amnicola lapidaria*, Say. "

LAND SHELLS

33. *Helix minuscula*, Binney. Council Bluffs, Nebraska Territory.
 34. *Helix lineata*, Say. " "
 35. *Helix striatella*, Anthony. Council Bluffs, Nebraska Territory.
 36. *Helix inflecta*, Say. " "
 37. *Helix hirsuta*, Say. " "
 38. *Helix solitaria*, Say. " "
 39. *Helix alternata*, Say. " "
 40. *Helix elevata*, Say. " "
 41. *Helix fallax*, Say. " "
 42. *Helix concava*, Say. " "
 43. *Helix ligera*, Say. " "
 44. *Helix profunda*, Say. Near Fort Leavenworth, Kansas Territory.
 45. *Helix multilineata*, Say. " "
 46. *Helix monodon*, Rackett. " "
 47. *Helix pulchella*, Mull. " "
 48. *Helix costata*, Mull. " "
 49. *Helix arborea*, Say. Drift on the Missouri, near Fort Berthold.
 50. *Helix cheresina*, Say. " "
 51. *Helix electrina*, Gould. " "
 52. *Helix cooperi*, (new spec.,) Binney. Black Hills, Nebraska Territory.
 53. *Pupa nebraskana*, (new spec.,) W. G. Binney. Fort Berthold, Nebraska Territory.
 54. *Pupa blandi*, (new spec.,) W. G. Binney. Fort Berthold.
 55. *Pupa armigera*, Say. " "
 56. *Pupa pentodon*, Say. Council Bluffs, Nebraska Territory.
 57. *Pupa modesta*, Say. " "
 58. *Pupa badia*, Adams. " "
 59. *Bulimus lubricus*, Mull. Fort Berthold, on Missouri.
 60. *Succinea venusta*, Say. Yellowstone.
 61. *Succinea retusa*, Lea. "
 62. *Succinea Haydeni*, (new spec.,) W. G. Binney. Yellowstone.
 63. *Succinea lineata*, (new spec.,) W. G. Binney. Fort Union and Yellowstone.
 64. *Succinea Nuttalliana*, Lea. Fort Union.
 65. *Succinea obliqua*, Say. Fort Berthold, Nebraska Territory.

BOTANY.

The collection of recent plants from the upper Missouri is very large and numerous in species. Comparatively few of them have been determined and their names presented in this list. The complete catalogue, with the necessary remarks and descriptions of new species, will appear in the final report.

The vegetation of Kansas and the southern and southeastern portions of Nebraska is luxuriant in the highest degree. The broad bottom prairies of the Missouri, from Council Bluffs to the mouth of the Niobrara, are of inexhaustible fertility, sustaining a vegetation variable in its character and of enormous growth. The upland prairies possess a soil composed of yellow marl, well adapted to agriculture and grazing. All that portion of Nebraska which borders upon the Missouri, for one hundred to one hundred and fifty miles into the interior, is already settled to a great extent, and the traveller sees in prospective many of the finest farms in the west. The beautiful valley of the Platte cannot be surpassed for fertility of soil and the variety and luxuriance of its vegetation. Scarcely a section of land can be seen at the present time that is not already occupied by the courageous and persevering pioneer, and made to yield most abundant crops. Sufficient timber occurs along the banks of ravines and streams for all economical purposes. After passing above latitude 43° , the soil becomes less fertile, climate much drier, and vegetation less luxuriant. The whole country, though well adapted for the purposes of pasturage, is not well suited for agriculture, except in comparatively few localities. There is very little timber but that which skirts the streams, and consists for the most part of cottonwood, elm, ash, and box wood. Reaching the mountains, as the Bear's Paw, Snowy, Girdle, Black hills, or Laramie hills, an inexhaustible supply of pine timber is found, with many other varieties of trees common to the northern regions. The numerous broad valleys in the Black hills possess a very fertile soil and abound in springs of pure water, and the time cannot be far distant when this region as well as the country around Fort Laramie will be settled by a thriving population, and the vast forests of pine rendered serviceable to the wants of man.

That there is a marked improvement in the character of the country as we approach the mountains has already been noticed in published reports. The valley of the Yellowstone river, after passing the mouth of the Big Horn, is spoken of by both traders and Indians as quite fertile, abounding with excellent timber, fine clear springs of water, and a luxuriant vegetation. The Crows who now possess this region regard it as the finest country in the world. The immense beds of gypsum, of the Jurassic formation, along the eastern slope of the Rocky mountains, some of which are twenty feet in thickness, would furnish an inexhaustible supply of that excellent fertilizer.

Much might be said in regard to the influence of soil, climate, geological structure, &c., upon the vegetation of the upper Missouri, as well as the geographical distribution of species; but time will not

permit, though many facts have been gathered bearing upon these points. These will appear with the more complete catalogue when the final report is published.

The following meteorological notes were taken at Fort Pierre and vicinity in the spring of 1855, and though very brief may prove of some interest:

March 7.—Weather fair; grass starting up fresh and green near Black hills. Grasshoppers and ants quite active. Antelope returning to the open prairies from their winter home in the north.

March 8.—Weather very fine and warm. Saw common striped snake, (*Eutania parietalis*.)

March 9.—Saw red-headed woodpecker, (*Melanerpes erythrocephalus*,) and in company with it a beautiful black glossy woodpecker about the same size, (*Melanerpes torquatus*.)

March 10.—Saw two fine plants on the south side of Bear Peak, six hundred feet above the level prairie around it. One of them *Anemone patens*, was in blossom, the other was just coming into bloom.

The ice broke up in the Missouri river March 6th, as far as Fort Clark, lat. 47°. Then came several days of stormy weather, during which the river was frozen over a second time so firm as to sustain heavily loaded teams. The ice again broke up on the 22d for about the same distance up the Missouri. At Fort Union the ice did not yield until the 3d of April.

April 9.—Four species of umbeliferous plants in bloom; heavy frost during the night, so that ice formed upon the little pools an inch in thickness; grasshoppers quite active and abundant.

April 10.—Cold; some snow.

April 11.—Fair weather; a strong breeze blowing though quite warm. A small species of *Carex* in blossom. Saw yellow-shafted flicker, (*Colaptes auratus*,) and meadow lark, (*Sturnella neglecta*.) At night the frogs commenced a gentle croaking, for the first time this spring.

April 12.—Various kinds of insects quite abundant; common garter snake, (*E. parietalis*,) killdeer, (*Charadrius vociferus*,) geese and ducks abundant; American elm (*Ulmus americana*,) in full bloom.

April 13.—Saw a large flock of swans, (*Cygnus buccinator*;) a beautiful *Ranunculus* in bloom, (*R. glaberrimus*.) The long-billed curlew (*Numenius longirostris*,) quite abundant running on the upland prairie.

April 16.—The 13-lined squirrel (*Spermophilus tridecem lineatus*,) quite abundant on the high prairie.

April 20.—Saw to-day, birds: wild geese, (*Anser erythropus*,) king-bird, (*Tyrannus crinitus*,) robin redbreast, (*Turdus migratorius*,) (a few robins were seen near Fort Pierre, April 1st,) the meadow lark, flicker, killdeer, turkey buzzard, (*Cathartes aura*,) mourning dove, (*Ectopistes carolinensis*,) common cowbird, (*Molothrus pecoris*,) very abundant; also a gull (*Larus franklinii*,) was seen on the river. The following plants were in bloom: *Astragalus caryocarpus*, *Shepherdia argentea*, a species of *Salix*, *Populus angulata*, and a fine bluebell, *Mertensia virginica*.

April 23.—Red winged blackbird (*Agelaius phoeniceus*,) abundant. *Prunus americana* in bloom ; *Symphoricarpus occidentalis* and *Artemisia* in full foliage.

May 6.—Saw blue heron, (*Ardea herodias*;) *Cornus stoloniferus* in bloom.

May 7.—Kingfisher (*Ceryle alcyon*,) seen on the Teton river.

May 8.—Saw cliff swallow (*Cotyle riparia*;) also a large rattlesnake (*Crotalus confluentus*;) *Castilleja sessiliflora* in full bloom.

May 9.—*Senecio aureus*, a species of *Salix*, and a *Juncus* in full bloom.

May 10.—In the valley of White river the trees are in full foliage, and the bottom and upland prairies are covered with a rich green carpet of grass, and multitudes of plants are now in blossom. *Malvastrum coccineum* just coming into bloom. *Mammalaris nuttalli* and *Allium stellatum* are in full bloom.

May 12.—*Ranunculus aquatilis* in bloom. At this time, so many birds and flowers, strange to me, have made their appearance that I cannot indicate them. Spring has fairly arrived, and summer is approaching. During the month of May considerable rain fell, so that the streams were much swollen. But for six or eight months past we have had very little rain, not more than one or two inches. All the vegetation was parched with drought.

The "June rise" is said, by the mountaineers, to commence invariably at the time when the roses are in bloom. This year the roses were in blossom June 1st, though I saw some in flower May 14th in the White river valley. The rise in the waters of the Missouri commenced at Fort Pierre, June 11th, 4 inches the first day, 5 inches the second, 18 inches the third, 4 to 8 inches the fourth, and afterward falling gradually. This is usually called by the mountaineers the "big rise," and is due to the melting of the snows, which accumulate during the winter in the ravines and valleys of the mountains near the sources of the Missouri. There was comparatively little snow in the mountains last winter, and there has been very little rain during the spring, consequently the rise this year is quite small.

June 1.—*Yucca angustifolia*, *Polygala alba*, *Opuntia missouriensis*, are in full bloom. The cacti bear the most beautiful blossoms of any of the plants of the prairie.

The principal part of the plants enumerated in the following catalogue were identified by the distinguished botanist, Dr. George Engelmann, of St. Louis, Missouri. A few were determined by Dr. Torrey, and the remainder by the writer. A good collection of mosses, lichens and fungi was obtained, but the species have not yet been studied, though they will be ready for the final report. It will be seen therefore that no department of the geology and natural history of the upper Missouri has been neglected in our explorations.

1. *Clematis Virginiana*, Linn. Very abundant from the mouth of the Missouri to Council Bluffs.
2. *Clematis ligusticifolia*, Nutt. Fort Pierre to the mountains. Very abundant about Fort Union; also at Fort Laramie, head of the Platte.

3. *Pulsatilla patens*, D. C. This plant is called by the Indians the harbinger of spring. I saw it on the south side of Bear Peak, March 9, 1855, just coming into bloom. It is found quite abundantly in the White river valley; also in the sand hills of Loup Fork.
4. *Anemone Pennsylvanica*, Linn. Abundant from the mouth of the Missouri to the mountains, though most common below latitude 43°.
5. *Anemone Caroliniana*, Walt. Quite common around Council Bluffs to Niobrara river.
6. *Anemone cylindrica*, Gray. This plant is quite rare; only a few individuals were seen near the mouth of the Big Sioux river, and on Loup Fork.
7. *Ranunculus repens*, var *Marylandicus*, Torr. and Gray. Low, wet places on the Upper Missouri.
8. *Ranunculus Pennsylvanicus*, Linn. Council Bluffs; Niobrara; Platte valley.
9. *Ranunculus recurvatus*, Poir. Mouth of the Missouri to Niobrara river; also sparingly in White river valley.
10. *Ranunculus abortivus*, Linn. Wet and sandy places to Niobrara; sparingly to the mountains.
11. *Ranunculus sceleratus*, Linn. Not rare throughout the upper Missouri country.
12. *Ranunculus glaberrimus*, Hook. The only locality in which I ever saw this plant was at Grindstone Hills, near Bad Lands, where it was in bloom on the 9th of April.
13. *Ranunculus cymbalaria*, Pursh. Seen on the Yellowstone and Missouri.
14. *Ranunculus aquatilis*, Linn. Very abundant in the White river valley, in the streams, and little lakes.
15. *Myosurus minimus*, Linn. Missouri bottoms, opposite St. Joseph's; also on the upland prairie, near Fort Pierre.
16. *Aquilegia Canadensis*, Linn. Does not extend above Council Bluffs or the Big Sioux.
17. *Isopyrum bitermatum*, Torr. and Gray. Seen sparingly as far up the Missouri as the mouth of the Platte.
18. *Delphinium tricornis*, Mich. Extends to the mouth of the Big Sioux; range to Niobrara, in latitude 43°.
19. *Delphinium azureum*, Mich. Abundant on the open prairies to the mountains.
20. *Delphinium virescens*, Nutt. Fort Pierre.
21. *Thalictrum cornuti*, Linn. Not rare to mountains.
22. *Thalictrum dioicum*, Linn. Abundant to Niobrara river.
23. *Hydrastis Canadensis*, Linn. Found only in the carboniferous limestone region to Council Bluffs; perhaps rarely to Big Sioux river.
24. *Actea rubra*, Bigelow. Council Bluffs.
25. *Asimina triloba*, Dunal. Common Papaw. Extends up the Missouri to the mouth of the Big Sioux river.

26. *Menispermum Canadensis*, Linn. Most abundant in the limestone regions to Council Bluffs; seen rarely on wooded banks to the Yellow-stone.
27. *Berberis aquifolium*, Pursh. A very abundant shrub in the Laramie range of hills and Black Hills.
28. *Podophyllum peltatum*, Linn. Abundant along the lower part of the Missouri river, gradually ceasing at the mouth of the Platte.
29. *Nelumbium luteum*, Willd. Lower portion of the valley of the Platte, and on the broad, wet bottoms about Omaha city. It is now quite rare on account of the great use of both roots and seeds for food, by the Omaha, Otoe, and Pawnee Indians.
30. *Nymphaea odorata*, Sit. Found by Dr. Cooper in Kansas.
31. *Argemone Mexicana*, Linn. Found only at Bellevue, Nebraska Territory; fine yellow flowers.
32. *Argemone hispida*, Gray. Bad Lands, White river, Loup Fork, Fort Laramie.
38. *Sanguinaria Canadensis*, Linn. Rich woods about Council Bluffs.
34. *Corydalis aurea*, Willd. Not seen on the bottoms to mountains.
35. *Dicentra cucullaria*, D. C. In shady woods to mouth Big Sioux.
36. *Nasturtium palustre*, D. C. Not uncommon to mountains.
37. *Nasturtium obtusum*, Nutt. On the upper Missouri and Yellow-stone.
38. *Nasturtium sinuatum*, Nutt. Fort Clark, Upper Missouri.
39. *Nasturtium sesiliflorum*, Nutt. Along Missouri.
40. *Nasturtium limosum*, Nutt. Along low bottoms near to Council Bluffs.
41. *Dentaria laciniata*, Muhl. Shady woods around Council Bluffs.
42. *Nasturtium calycinum*, Engelmann nov. sp.

Annum erectum seu diffusum, hirsutulum; folis caulinis anguste oblongis sinuatis seu subpinnatifidis basi auriculata arcte sessilibus vel semi amplexicaulibus; racemis confertifloris demum elongatis; pedicellis flore flavido et silicula ovoidea acuta parva hispida cum stylo gracilis vix longioribus; calyce persistente.

Sandy bottoms of the Yellowstone river, Fort Sarpy to Fort Union.—In aspect as well as in the style, (fully a line long on a silicle $1\frac{1}{2}$ line in length,) this species resembles some *vesicariae*, but the numerous seeds are those of a *nasturtium*. The stem is about a foot high, often much branched and diffuse. The ovate lanceolate acutish sepals commonly persist until the valves of the pod have fallen. The pubescence of the pod consists of very short and pointed thick-based simple hairs. (A. Gray.)

43. *Arabis Canadensis*, Linn. Common along Missouri to Fort Union.
44. *Arabis hirsuta*, Scop. Fort Union and Bad Lands.
45. *Arabis laevigata*, D. C. Shady woods to mouth of Platte.
46. *Arabis dentata*, Torr. and Gray. Council Bluffs.
47. *Sisymbrium canescens*, Nutt. Fort Pierre and Yellowstone.

48. *Erysimum asperum*, D. C. Abundant on the high prairies to Fort Pierre and Fort Union.
49. *Erysimum cheiranthoides*, Linn. Yellowstone and Bad Lands.
50. *Stanleya pinnatifida*, Nutt. Abundant on the marl banks near Niobrara river, Fort Pierre, rarely on the Yellowstone.
51. *Stanleya integrifolia*, James. Dr. Gray thinks it is a different form of last species.
52. *Vesicaria ludoviciana*, D. C. Sterile hills, Fort Pierre, and Yellowstone.
53. *Vesicaria alpina*, Nutt. Same as preceding.
54. *Vesicaria didymocarpa*, Hook. Bad Lands.
55. *Sinapis nigra*, Linn. About old houses and cultivated fields, Council Bluffs, and Fort Pierre.
56. *Capsella bursa-pastoris*, Linn. Same as preceding.
57. *Draba micrantha*, Nutt. Bad Lands.
58. *Draba Caroliniana*, Walt. Council Bluffs.
59. *Draba brachycarpa*, Nutt. Lower Missouri.
60. *Lepidium ruderales*, Linn. Along Missouri to mountains.
61. *Lepidium Virginicum*, Linn. Fort Pierre and Yellowstone.
62. *Cleome integrifolia*, Torr. and Gray. Bad Lands, Fort Union, Yellowstone, Bad Lands of Judith, Platte valley, Fort Laramie, and not a generally diffused plant, but growing abundantly in localities.
63. *Polanisia uniglandulosa*, Gray. First seen on gravelly hills about Fort Pierre; also on Loup Fork.
64. *Viola palmata*, Linn. Fort Pierre.
65. *Viola cucullata*, Sit. Fort Pierre.
66. *Viola Nuttallii*, Pursh. Bad Lands.
67. *Viola Canadensis*, Linn. Fort Pierre.
68. *Viola tricolor*, Linn. Council Bluffs.
69. *Viola delphinifolia*, Nutt. Prairies around Council Bluffs.
70. *Silene antirrhina*, Linn. Council Bluffs.
71. *Silene stellata*, Ait. Dixon's Bluffs.
72. *Alsine Michauxi*, Fenzl. Mouth Big Sioux.
73. *Cerastium nutans*, Raf. White river, Bad Lands.
74. *Cerastium arvense*, Linn. Council Bluffs.
75. *Moehringia lateriflora*, Linn. Along Missouri to Council Bluffs.
76. *Paronychia sessiliflora*, Nutt. Fort Union, Laramie Peak, Black Hills.
77. *Stellaria longipes*, Goldie. Council Bluffs.
78. *Portulaca oleracea*, Linn. On saline clay soil, Teton river, near Fort Pierre; also near base of Black Hills, (indigenous.)
79. *Claytonia Virginica*, Linn. Rocky woods, as high up the Missouri as Council Bluffs.
80. *Abutilon avicennae*, Gaertn. Naturalized near Council Bluffs.
81. *Malvastrum coccineum*, Gray. Makes its appearance on the Missouri about latitude 43°, and continues to the mountains.
82. *Tilia Americana*, Linn. Abundant to Big Sioux; seen sparingly to mouth of Niobrara, where it ceases.
83. *Linum rigidum*, Pursh. Throughout the prairie portion of the upper Missouri.

84. *Linum perenne*, Linn. Fort Pierre and Fort Union.
85. *Linum boottii*, Planchon. Found by Dr. Cooper in Kansas.
86. *Oxalis stricta*, Linn. Generally diffused.
87. *Oxalis violacea*, Linn. Rich prairies and cultivated fields around Council Bluffs; seen nearly as high as Niobrara, in full bloom June 20, 1857.
88. *Oxalis corniculata*, Linn. Upper Mo.
89. *Geranium maculatum*, Linn. Common to Niobrara.
90. *Geranium carolinianum*, Linn. Mouth Big Sioux
91. *Impatiens pallida*, Nutt. Shady woods to mountains.
92. *Impatiens fulva*, Nutt. Council Bluffs and Big Sioux.
93. *Xanthoxylum Americanum*, Mill. Woody bottoms, and islands of the Mo., to Fort Pierre.
94. *Ptelia trifoliata*, Linn. Around Council Bluffs.
95. *Rhus glabra*, Linn. Council Bluffs White river valley.
96. *Rhus copallina*, Linn. Abundant in Mo., and Kansas.
97. *Rhus toxicodendron*, Linn. Abundant in woody places to the mountains.
98. *Rhus aromatica*, Ait. Along Mo.
99. *Rhus trilobata*, Nutt. First makes its appearance about lat., 43°, and occurs abundantly on sterile hills to the mountains.
100. *Vitis riparia*, Michx. Banks of Mo., Bellevue, N. T.
101. *Vitis indivisa*, Willd. Big Sioux river.
102. *Ampelopsis quinquefolia*, Michx. Very common in woody bottoms throughout the country, but grows most luxuriant in the rich woods from mouth of Missouri to Big Sioux, where it often so clothes old dry trees that they seem still alive.
103. *Rhamnus lanceolatus*, Pursh. Council Bluffs.
104. *Ceanothus sanguineus*, Pursh. Mouth of White river.
105. *Ceanothus ovalis*, Bigelow, var. *pubescens*. Common on the cretaceous hills below Fort Pierre; also in the sand hills of Loup Fork, on the Niobrara river.
106. *Celastrus scandens*, Linn. Along Missouri to Fort Union.
107. *Euonymus atropurpureus*, Jacq. Woody bottoms to Fort Union.
108. *Euonymus Americanus*, Linn. Mouth of Platte.
109. *Staphylea trifolia*, Linn. Council Bluffs.
110. *Æsculus glabra*, Willd. Missouri bottoms to Big Sioux river.
111. *Acer dasycarpum*, Ehshart. Bellevue, Nebraska.
112. *Acer rubrum*, Linn. Highest limit on Missouri, latitude 42°.
113. *Acer saccharinum*, Wang. Limestone regions of Kansas and southern portion of Nebraska.
114. *Negundo aceroides*, Moench. One of the few trees which extends to the mountains.
115. *Polygala alba*, Nutt. On sterile hills to Fort Union.
116. *Polygala verticillata*, Linn. Moist places on prairies; Fort Pierre; Bad lands.
117. *Polygala senega*, Linn. Council Bluffs.
118. *Vicia Americana*, Muhl. Upper Missouri generally.
119. *Lathyrus linearis*, Nutt. Upper Missouri generally.

120. *Lathyrus polymorphus*, Nutt. White river valley.
121. *Lathyrus venosus*, Muhl. Rich bottoms, Big Sioux.
122. *Phaseolus pauciflorus*, Benth. Bad Lands.
123. *Amphicarpea monoica*, Nutt. White river valley, Fort Clark.
124. *Apios tuberosa*, Moench. Along sandy woody bottoms of Missouri. A species of mouse gathers large numbers of the tubers of this plant for his winter store. These "cachés," (as they are called,) are eagerly sought by the squaws, and the tubers taken and used as food. I have seen several bushels of the roots in a single lodge. Cooked with buffalo meat they make a very palatable dish.
125. *Glycyrrhiza lepidota*, Nutt. Diffused generally.
126. *Psoralea lanceolata*, Pursh. From Bellevue to Yellowstone.
127. *Psoralea floribunda*, Nutt. Big Sioux river to Bad Lands.
128. *Psoralea campestris*, Nutt. Bad Lands.
129. *Psoralea argophylla*, Pursh. A most beautiful plant, covering the plain as with silvery velvet. Big Sioux to mountains.
130. *Psoralea cuspidata*, Pursh. Fort Pierre to Bad Lands.
131. *Psoralea esculenta*, Pursh. Affords the Indians a very nourishing farinaceous root, upon which they subsist almost entirely in the spring and early summer months, when game is scarce. It is also a great favorite of the grizzly bear.
132. *Amorpha fruticosa*, Linn. A common shrub, above Missouri to mountains.
133. *Amorpha canescens*, Nutt. Very abundant on the upland prairies, Loup Fork, and Niobrara river.
134. *Amorpha nana*, Nutt. Fort Laramie and high up the Missouri.
135. *Dalea aurea*, Nutt. Bad Lands.
136. *Dalea alopecuroides*, Willd. Big Sioux river.
137. *Dalea laxiflora*, Pursh. Fort Pierre to Yellowstone.
138. *Petalostemum candidum*, Mich. Big Sioux river.
139. *Petalostemum multiflorum*, Nutt. Fort Pierre to Bad Lands.
140. *Petalostemum violaceum*, Mich. Upper Missouri to Bad Lands.
141. *Petalostemum villosum*, Nutt. Bad Lands.
142. *Trifolium stoloniferum*, Muhl. Bad Lands.
143. *Trifolium pratense*, Linn. Lower Missouri.
144. *Trifolium repens*, Linn. Lower Missouri.
145. *Hosackia Purshiana*, Benth. Sandy bottoms of Missouri.
146. *Astragalus hypoglottis*, Linn. White river to Bad Lands.
147. *Astragalus gracilis*, Nutt. Bad Lands to the Yellowstone.
148. *Astragalus striatus*, Nutt. Fort Pierre to Bad Lands, covering prairies like clover fields.
149. *Astragalus Missouriensis*, Nutt. Fort Pierre to Fort Union.
150. *Astragalus caryocarpus*, Ker. Fort Pierre to Bad Lands.
151. *Astragalus Plattensis*, Nutt. Fort Pierre.
152. *Astragalus Canadensis*, Linn. Fort Pierre to Bad Lands.
153. *Astragalus racemosus*, Pursh. Abundant in the sandy bottoms of Missouri; Cedar island.

154. *Astragalus Drummondii*, Douglass. Sterile hills around Fort Union.
155. *Astragalus adsurgens*, Pall. James river.
156. *Phaca caespitosa*, Nutt. Bad lands.
157. *Phaca longifolia*, Nutt. Bad lands.
158. *Phaca pectinata*, Hook. Upland prairies on the Yellowstone river, abundant.
159. *Phaca elongata*, Hook. Fort Pierre to Fort Union.
160. *Oxytropis Lamberti*, Pursh. Very abundant on praries around Big Sioux and Niobrara rivers.
161. *Oxytropis splendens*, Douglass. James river.
162. *Homalobus multiflorus*. Nutt. Big Sioux to bad lands.
163. *Kentrophyta montana*, Nutt. Abundant in sandy river bottoms on the Yellowstone.
164. *Hedysarum boreale*, Nutt. Abundant, mouth of Yellowstone.
165. *Desmodium Canadense*, D. C. Fort Clark.
166. *Desmodium Dillenii*, Darl. Big Sioux river.
167. *Desmodium paniculatum*, D. C. Bellevue, W. T.
168. *Desmodium nudiflorum*, D. C. Bellevue, W. T.
169. *Lepedera capitata*, Michx. Abundant on the rich bottoms about Council Bluffs, Big Sioux.
170. *Lepedera hirta*, Ell. On Missouri.
171. *Crotalaria sagittalis*, Michx. Big Sioux river.
172. *Lupinus pusillus*, Pursh. Common on the Yellowstone.
173. *Lupinus perennius*, Linn. Platte valley.
174. *Thermopsis rhombifolia*, Nutt. From Council Bluffs to Fort Pierre; Bad Lands, &c.
175. *Sophora sericea*, Nutt. White River valley; Fort Pierre.
176. *Gleditschia tricanthos*, Linn. Occurs as high on the Missouri as Big Sioux.
177. *Cercis Canadensis*, Linn. Same as preceding.
178. *Cassia Chaemacrista*, Linn. Sandy bottoms of Missouri, from Council Bluffs to White river.
179. *Desmanthus brachylobus*, Benth. Council Bluffs and Platte valley; rich bottoms.
180. *Schrankia uncinata*, Willd. Gravelly hills on the upper Missouri generally.
181. *Gymnocladus Canadensis*, Lam. Abundant in woody bottoms to Big Sioux.
182. *Baptisia leucophea*, Nutt. Platte valley.
183. *Prunus Americana*, Marsh. Fort Pierre.
184. *Prunus pumila*, Linn. Abundant in the sand hills of Loup Fork; along Missouri river near Little Soldier's camp.
185. *Prunus serotina*, Ehrh. Council Bluffs.
186. *Prunus Virginiana*, Linn. Generally diffused.
187. *Gillenia stipulacea*, Nutt. Mouth of Big Sioux.
188. *Gillenia trifoliata*, Moench. Mouth of Big Sioux.
189. *Agrimonia eupatoria*, Linn. Bellevue, N. T.
190. *Agrimonia parviflora*, Ait. Around Fort Union.

191. *Chaemorrhodas erecta*, var. *Nuttallii*, Torr. & Gray. Big Bend and Yellowstone.
192. *Geum strictum*, Ait. White river to Yellowstone.
193. *Geum album*, Gmel. Fort Pierre and Mandan village.
194. *Geum triflorum*, Pursh. Fort Union.
195. *Potentilla Norvegica*, Linn. Council Bluffs to Yellowstone.
196. *Potentilla paradoxa*, Nutt. Along banks of Missouri.
197. *Potentilla effusa*, Dougl.? Prairies near Fort Clark.
198. *Potentilla Pennsylvanica*, Linn. var. *strigosa*; Bad Lands.
199. *Potentilla diversifolia*, Lehm. Bad Lands.
200. *Potentilla rigida*, Nutt. Yellowstone.
201. *Potentilla Canadensis*, Linn. Big Sioux river.
202. *Potentilla anserina*, Linn. Niobrara run to Fort Pierre.
203. *Potentilla fructicosa*, Linn. On the Yellowstone.
204. *Potentilla arguta*, Pursh. Fort Clark and Fort Union.
205. *Fragaria vesca*, Linn. Along Missouri to Yellowstone.
206. *Fragaria Virginica*, Ehsh. Fort Union.
207. *Sanguisorba annua*, Nutt. Fort Union.
208. *Rubus occidentalis*, Linn. Council Bluffs.
209. *Rubus strigosus*, Mich. Sparingly on Yellowstone.
210. *Rubus villosus*, Ait. Council Bluffs.
211. *Rosa blanda*, Ait. On prairies generally.
212. *Rosa lucida*, Ehrh. White river; Fort Pierre.
213. *Crataegus punctata*, Jacq. White river; Big Bend, &c.
214. *Crataegus tomentosa*, var. *mollis*, Gray. Mouth of Big Sioux.
215. *Amelanchier Canadensis*, Torr. and Gray. Common throughout the upper Missouri country; bears a delicious fruit which ripens in June.
216. *Epilobium angustifolium*, Linn. Not uncommon in Kansas, also near Council Bluffs.
217. *Oenothera biennis*, Linn. Common along the valley of Missouri to the mountains.
218. *Oenothera albicaulis*, Nutt. White river valley and Yellowstone; rare.
219. *Oenothera cespitosa*, Nutt. Arid hills of upper Missouri.
220. *Oenothera serrulata*, Nutt. Council Bluffs to Fort Pierre.
221. *Oenothera pinnatifida*, Nutt. Bad Lands.
222. *Gaura biennis*, Linn. Along Missouri to Council Bluffs.
223. *Gaura coccinea*, Nutt. Common on high prairies and hills from Council Bluffs to the mountains.
224. *Ludwigia palustris*, Ell. Wet places in Platte valley, near Loup Fork.
225. *Circea lutetiana*, Linn. Fertile woody places along Missouri to Niobrara.
226. *Myriophyllum spicatum*, Linn. Common in ponds throughout upper Missouri.
227. *Hepparis vulgaris*, Linn. In standing pools, upper Missouri.
228. *Mentzelia ornata*, Torr. and Gray. Arid argillaceous hills from latitude 43° to the mountains.
229. *Mentzelia nuda*, Torr. and Gray. Same as preceding.

230. *Opuntia Missouriensis*, D. C. Common throughout the upper Missouri region.
231. *Opuntia fragilis*, Nutt. Peculiar to arid plains, upper Missouri.
232. *Opuntia*.
233. *Mammalaris vivipara*. Seen on the rich bottoms between Niobrara and Fort Pierre; bears beautiful purple blossoms.
234. *Mammalaris Nuttalli*. Common throughout the upper Missouri country above Fort Pierre; most abundant in White river valley.
235. *Ribes Missouriensis*, Nutt. Woody limestone banks around Council Bluffs.
236. *Ribes floridum*, Linn. Common on the upper Missouri and valley of Yellow stone.
237. *Ribes aureum*, Pursh. Banks and ravines along Missouri and Yellow stone.
238. *Echinocystis lobata*, Torr. and Gray. Durions' hills on Missouri.
239. *Penthorum sedoides*, Linn. In wet places, Platte valley; mouth of Loup Fork.
240. *Heuchera Americana*, Linn. Not rare in woody places along Missouri.
241. *Hamamelis Virginica*, Linn. Abundant in limestone woods along Missouri to mouth of the Platte river.
242. *Zizia aurea*, Koch. Prairies along Missouri to Big Sioux and Niobrara.
243. *Polytaenia Nuttallii*, D. C. Dry argillaceous hills and upland prairies around Fort Pierre; also on the Yellow stone.
244. *Sium lineare*, Michx. Moist places from mouth of Missouri to mountains.
245. *Thaspium barbinode*, Nutt. Rich woody places along Missouri.
246. *Thaspium aureum*, Nutt. Near Council Bluffs.
247. *Peucedanum faeniculaceum*, Nutt. Common on high prairies around Council Bluffs.
248. *Osmorrhiza longistylis*, D. C. Moist fertile woods to Fort Pierre.
249. *Osmorrhiza brevistylis*, D. C. With the preceding.
250. *Cicuta maculata*, Linn. Wet places, Platte valley.
251. *Aralia nudicaulis*, Linn. Limestone woods to Big Sioux river.
252. *Cornus florida*, Linn. Along the rich wooded bottoms as high as Fort Leavenworth.
253. *Cornus stolonifera*, Michx. Wooded bottoms of Missouri from mouth to source.
254. *Cornus sericea*, Linn. Abundant along Missouri bottoms. The inner bark is much used by the Sioux Indians with their tobacco in proportions of three to one; called by the traders "red osier."

255. *Symphoricarpus occidentalis*, R. Br. The most abundant shrub along the rivers and streams from the mouth of the Missouri to the mountains; often called "blue wood," much used for making brooms; sometimes covers the river bottoms almost exclusively.
256. *Lonicera ciliata*, Muhl. Woody ravines, near Council Bluffs, N. T.
257. *Triosteum perfoliatum*, Linn. Not rare as high up the Missouri as mouth of Big Sioux.
258. *Sambucus Canadensis*, Linn. Common along Missouri; seen in the valley of Yellowstone.
259. *Galium aparine*, Linn. Woody places along Missouri.
260. *Galium trifidum*, Linn. Moist low spots on Missouri.
261. *Galium boreale*, Linn. Same as preceding.
262. *Galium triflorum*, Michx. Same as preceding.
263. *Cephalanthus occidentalis*, Mich. Platte valley near Loup Fork.
264. *Oldenlandia angustifolia*, Gray. Along Missouri to Council Bluffs.
265. *Vernonia fasciculata*, Michx. Quite common on prairies, valley of Missouri.
266. *Kuhnia eupatorioides*, Linn. Council Bluffs to Niobrara.
267. *Eupatorium perfoliatum*, Linn. On rich bottom prairies near mouth of Big Sioux.
268. *Eupatorium purpureum*, Linn. Council Bluffs to James river.
269. *Eupatorium ageratoides*, Linn. Woody bottoms Council Bluffs to Fort Pierre.
270. *Liatris spicata*, Willd. Rich bottoms, Big Sioux.
271. *Aster cordifolius*, Linn. Not uncommon, Big Sioux and Niobrara.
272. *Aster saggitifolius*, Willd. Big Sioux and Niobrara.
273. *Aster azureus*, Lindl. Council Bluffs.
274. *Aster multiflorus*, Ait. Council Bluffs.
275. *Aster sericeus*, Vent. Fort Pierre.
276. *Aster Novae-Angliae*, Ait. Low places on Missouri.
277. *Aster laevis*, Linn. Upper Missouri.
278. *Erigeron pumilum*, Nutt. High hills around Fort Pierre.
279. *Erigeron strigosus*, Muhl. Low places, Vermilion Prairie.
280. *Erigeron Philadelphicus*, Linn. Alluvial bottoms of Missouri.
281. *Erigeron Canadense*, Linn. Common all over Missouri country.
282. *Aplopappus spinulosus*, D. C. High prairies of Upper Missouri.
283. *Solidago rigida*, Linn.
284. *Solidago incana*, Torr & Gray.
285. *Solidago nemoralis*, Ait.
286. *Solidago gigantea*, Ait.
287. *Solidago Missouriensis*, Nutt.
288. *Grindelia squarrosa*, Dunal. Common on high prairies from lat. 43° to the mountains; medicinal among Indians.
289. *Chrysopsis villosa*, Nutt. Common on dry hills, Fort Pierre.

290. *Silphium laciniatum*, Linn. Called by the inhabitants of the country, "Compass plant;" reaches its healthiest growth on the rich fertile bottoms of Missouri, but often found in great abundance on the high prairies. The highest point on the Missouri river that I have observed this plant is near lat. 44°, mouth White river; most abundant in the Platte valley and on the broad rich bottoms between Council Bluffs and Niobrara river, where it sometimes occupies large areas to the exclusion of other vegetation. That the leaves of this plant set their faces north and south, may be proved by a pocket compass. Forty-nine plants out of fifty exhibit this peculiarity. It thus becomes an excellent guide to the traveller across the pathless prairies.
291. *Silphium perfoliatum*, Linn. Seldom seen above Niobrara.
292. *Iva axillaris*, Pursh. Dry argillaceous hills. Fort Pierre and Fort Union.
293. *Ambrosia trifida*, Linn. Along streams and borders of woods from mouth of the Missouri to mountains. Quite abundant.
294. *Ambrosia coronopifolia*, Torr. and Gray. Fort Pierre.
295. *Xanthium strumarium*, Linn. Sandy bottoms of Yellow-stone.
296. *Echinacea purpurea*, Moench. Purple cone flower; called Rattlesnake weed in the west, and is found abundantly throughout the country. Root very pungent. Used very effectively by the traders and Indians for the cure of the bite of the rattlesnake.
297. *Lepachys columnaris*, Torr. and Gray. Common throughout the Missouri country, but most abundant from Council Bluffs to Niobrara river, on the rich broad-bottom prairies. In flower July 8th. Rays usually yellow, sometimes of a deep purple velvet.
298. *Lepachys pinnata*, Torr. and Gray. Vermilion prairie. Rare.
299. *Rudbeckia hirta*, Linn. Council Bluffs.
300. *Heliopsis leavis*, Pers. Along streams in Kansas and southern Nebraska.
301. *Helianthus giganteus*, Linn. Common on Upper Missouri.
302. *Helianthus gross-serratus*, Martens. Common on prairies.
303. *Coreopsis tripteris*, Linn. Council Bluffs.
304. *Coreopsis tinctoria*, Nutt. James river, Big Sioux, &c.
305. *Actinomeris squarrosa*, Nutt. Common in thickets, and along streams in Kansas and Nebraska.
306. *Bidens connata*, Muhl. Missouri, and White river Valley.
307. *Bidens Beckii*, Torr. Council Bluffs.
308. *Dysodia chrysanthemoides*, Lag. Very abundant in prairie-dog villages on the upper Missouri.
309. *Helenium autumnale*, Linn. Kansas and southern Nebraska.
310. *Anthemis arvensis*, Linn. Naturalized to Fort Leavenworth.
311. *Achillea millefolium*, Linn. Found all over the prairie country of the west; must be indigenous west of the Mississippi.
312. *Antennaria plantaginacea*, R. Br. Upper Missouri and Black Hills.

313. *Antennaria dioica*, R. Br. Same as last.
314. *Artemisia filifolia*, Torr. Gravelly hills along Platte; "Bad Lands."
315. *Artemisia cana*, Pursh. In the valley of Missouri and Platte.
316. *Artemisia frigida*, Willd. From latitude 43° to mountains.
317. *Artemisia dracunculoides*, Fort Pierre to Bad Lands.
318. *Artemisia tridentata*, Nutt. Common in Bad Lands.
319. *Artemisia biennis*, Willd. In Platte Valley.
320. *Artemisia Canadensis*, Michx. Near Fort Laramie.
321. *Artemisia ludoviciana*, Nutt. Shyenne river.
322. *Gnaphalium uliginosum*, Linn. Council Bluffs.
323. *Senecio aureus*, Linn. Council Bluffs and Big Sioux.
324. *Senecio integerrimus*, Nutt. About Council Bluffs to mountains.
325. *Linosyris graveolens*, Torr. and Gray. A very common shrub from latitude 44° to mountains; sometimes associated with *Sarcobatus vermicularis*, and sometimes taking its place.
326. *Cacalia tuberosa*, Nutt. Not uncommon on the rich bottoms of the Missouri and Platte.
327. *Lygodesmia juncea*, Don. A very abundant plant all over the sterile hills of the Upper Missouri and its tributaries; grows most luxuriantly on the second upland prairie. It makes its first appearance near Council Bluffs, and extends to the mountains.
328. *Cirsium altissimum*, Spreng. Platte valley.
329. *Brickelia oblongifolia*. Along Missouri river.
330. *Franseria ambrosioides*, Cab. Sandy bottoms of the Yellowstone.
331. *Sonchus asper*, Vill. Council Bluffs.
332. *Mulgedium pulchellum*, Nutt. Big Sioux river.
333. *Troximon cuspidatum*, Pursh. Council Bluffs and Big Sioux.
334. *Lobelia cardinalis*, Linn. Moist places along the Missouri to the Big Sioux; in Kansas, on Big Cottonwood creek.
335. *Lobelia spicata*, Lam. Mouth of the Platte.
336. *Lobelia inflata*, Linn. Yellow-stone valley, where it is cultivated by the Crow Indians, and used in their religious ceremonies.
337. *Campanula rotundifolia*, Linn. Common to Fort Clark.
338. *Specularia perfoliata*, D. C. Throughout the Upper Missouri country.
339. *Arctostaphylos uva-ursa*, Spreng. Very abundant on the high rocky hills about Fort Clark; also abundant in the mountains. It is the real "Kininkinnick" of the Indians, and used by them to mix with their tobacco, in preference to any other plant. The bark of *Cornus sericea* is used as a substitute only in the absence of the *A. uva-ursi*.
340. *Chimaphila umbellata*, Nutt. Black Hills.
341. *Diospyros Virginiana*, Linn. Is found in Kansas.
342. *Plantago major*, Linn. On river bottom near Fort Clark.

343. *Plantago patagonica*, Var., *gnaphaloides*. Very abundant in sand soil and gravelly places on the Upper Missouri.
344. *Plantago pusilla*, Nutt. On prairies near Fort Pierre; also on the river opposite St. Joseph, in Kansas.
345. *Lysamachia stricta*, Ait. Platte valley, upon Missouri.
346. *Utricularia inflata*, Walt. In ponds, Council Bluffs, White river valley.
347. *Phelipaea ludoviciana*, Don. Sandy prairies, Yellowstone.
348. *Aphyllon fasciculatum*, Torr. & Gray. Great Bend of Missouri.
349. *Aphyllon uniflorum*, Torr. & Gray. Council Bluffs.
350. *Scrophularia nodosa*, Linn. Abundant along thickets and streams, Kansas and Nebraska.
351. *Chelone glabra*, Linn. Along valley of Missouri to latitude 43°.
352. *Penstemon grandiflorus*, Fraser. A beautiful plant found along the bluffs of the Platte, banks and sandy bottoms of Missouri to mountains.
353. *Penstemon ceruleum*, Nutt. Eagle Nest hill, White river valley.
354. *Penstemon erianthum*, Nutt. Hills around Fort Pierre.
355. *Penstemon albidum*, Nutt. Low with glabrous calyx. Hills around Fort Pierre.
356. *Penstemon cristatum*, Nutt. On high prairies; Upper Missouri.
357. *Penstemon gracile*, Nutt. Prairie bottoms, near Fort Pierre.
358. *Penstemon pubescens*, Solander. Fort Pierre; June.
359. *Penstemon levigata*, Solander. Fort Leavenworth; May.
360. *Mimulus virgeus*, Linn. Council Bluffs and Big Sioux.
361. *Mimulus Jamesii*, Torr. On the Platte. Dr. Cooper.
362. *Gratiola Virginica*, Linn. Quite common along the Missouri.
363. *Veronica anagallis*, Linn. Common; Council Bluffs.
364. *Veronica scutellata*, Linn. With the preceding.
365. *Veronica peregrina*, Linn. Fort Pierre.
366. *Gerardia purpurea*, Linn. Council Bluffs.
367. *Castilleja sessiliflora*, Pursh. Common about Council Bluffs.
368. *Castilleja septentrionalis*, Lindl. Black Hills.
369. *Melampyrum americanum*, Michx. Extends up the Missouri as far as the mouth of the Platte.
370. *Dianthera americana*, Linn. Platte valley.
371. *Verbena bracteosa*, Michx. A very common plant about prairie dog villages on the upper Missouri.
372. *Verbena hastata*, Linn. Platte valley.
373. *Verbena stricta*, Vent. Platte valley; July.
374. *Verbena aubletia*, Linn. Along the Missouri in Kansas.
375. *Lippia lanceolata*, Michx. Fort Leavenworth, Kansas Territory.
376. *Phryma leptostachya*, Linn. Not rare along the Missouri to latitude 43°.
377. *Mentha Canadensis*, Linn. Common in wet places, valley of the Missouri and Platte.
378. *Lycopus sinuatus*, Ell. Same as preceding.
379. *Monarda fistulosa*, Linn. Common along streams to mountains.
380. *Hedeoma hirta*, Nutt. Abundant in the prairie dog villages, upper Missouri.

381. *Blephilia ciliata*, Raf. Fort Pierre to Bad Lands.
382. *Lophanthus anisatus*, Benth. James river; on Missouri.
383. *Scutellaria parvula*, Michx. Council Bluffs.
384. *Tencrium Canadense*, Linn. Council Bluffs.
385. *Lithospermum canescens*, Lehm. High prairies, Council Bluffs.
386. *Lithospermum latifolium*, Michx. Fort Pierre.
387. *Myosotis glomerata*, Nutt. On dry sterile hills, Fort Pierre, and Bad Lands.
388. *Onosmodium hispidum*, Michx. Prairies about Leton river; Fort Pierre.
389. *Mertensia Virginica*, D. C. Fort Pierre; in bloom April 20, 1855.
390. *Echinosperrum patulum*, Lehm. Prairies about Fort Pierre.
391. *Echinosperrum lappulum*, Lehm. Prairies about Fort Pierre.
392. *Hydrophyllum Virginicum*, Linn. Shady woods as high up the Missouri as mouth of White river, and in White river valley. Most abundant in the carboniferous limestone regions of Council Bluffs; April.
393. *Hydrophyllum macrophyllum*, Nutt. With preceding.
394. *Ellisia nyctelea*, Linn. About old houses and gardens to Big Sioux, and along old roads in prairie dog villages on the upper Missouri.
395. *Phacelia circinata*, Jacq. In Kansas; Dr. Cooper.
396. *Phlox divaricata*, Linn. Council Bluffs and Platte valley.
397. *Collomia linearis*, Nutt. Common about Fort Pierre; Fort Union.
398. *Gilia longiflora*, Torr. In sand hills of Niobrara river.
399. *Ipomea leptophylla*, Torr. I have seen this plant in but one locality along the Missouri; Bear creek near "Bad Lands." But in the sand hills on Loup Fork, along the Niobrara, and around Fort Laramie; it is very abundant.
400. *Cuscuta glomerata*, Choisy. Abundant on sandy bottoms of Missouri.
401. *Solanum nigrum*, Michx. Not rare on the sandy bottoms of Missouri.
402. *Solanum triflorum*, Nutt. Very abundant in prairie dog villages on Upper Missouri.
403. *Solanum Carolinense*, Linn. Along Missouri to Council Bluffs.
404. *Physalis lanceolata*, Michx. Sandy bottoms of Missouri to Fort Pierre.
405. *Physalis viscosa*, Linn. Sandy bottoms of Missouri to mountains.
406. *Androcera lobata*, Nutt. Very abundant about old trading houses, along old roads, and in prairie dog villages on Upper Missouri.
407. *Apocynum cannabinum*, Linn. Abundant on low bottoms of Missouri to mountains.
408. *Asclepias macranthera*, Torr. Not rare on the moist prairies of upper Missouri, Loup Fork, Platte valley; July 16.
409. *Asclepias incarnata*, Linn. Moist places Loup Fork, Platte.

410. *Asclepias tuberosa*, Linn. Mouth Big Sioux. and in Platte valley.
411. *Asclepias verticillata*, Linn. Abundant on prairies; Fort Pierre.
412. *Anantherix viridis*, Nutt. Platte valley; Loup Fork; July 16.
413. *Acerates longifolia*, Nutt. Common around Fort Pierre.
414. *Acerates angustifolia*, Nutt. With preceding.
415. *Fraxinus Americana*, Linn. Generally diffused.
416. *Asarum Canadense*, Linn. Near Council Bluffs.
417. *Oxybaphus angustifolius*, Torr. Dry hills around Fort Pierre.
418. *Chenopodium album*, Linn. Platte valley; Fort Pierre.
419. *Obione canescens*, Moq. "Bad Lands;" common.
420. *Salicornia herbacea*, Linn. Saline places; Fort Union.
421. *Sarcobatus vermicularis*, Nees. This is one of the most abundant shrubs on the Upper Missouri. It makes its first appearance near latitude 44°, and seems to thrive best in the saline clays of the cretaceous and tertiary formations. It is sometimes called "Grease wood" by the traders, and is often used for fuel by them on the Yellowstone river, where it grows to the height of ten or twelve feet, with trunks two to three inches in diameter. On the Yellowstone and along the Missouri it sometimes covers many square miles to the exclusion of other plants.
422. *Amaranthus albus*, Linn. Sandy bottoms and shores of Missouri.
423. *Rumex persicarioides*, Linn. Sandy bottoms of Missouri.
424. *Rumex venosus*, Pursh. Old Ponca village; Loup Fork.
425. *Polygonum amphibium*, Linn. Low wet places along Missouri.
426. *Polygonum aviculare*, Linn. Council Bluffs along Missouri.
427. *Polygonum tenue*, Michx. Council Bluffs to mountains.
428. *Benzoin odoriferum*, Nees. Woody bottoms along Missouri, below Niobrara.
429. *Shepherdia argentea*, Nutt. Very abundant from mouth of Big Sioux river to the mountains. It bears a profusion of red acid fruit, called buffalo berries.
430. *Eleagnus argentea*, Pursh. I have seen this shrub in but one locality in Missouri, near Fort Clark, on the high tertiary hills.
431. *Comandra umbellata*, Nutt. Fort Pierre and on the Yellowstone.
432. *Euphorbia corollata*, Linn. Quite common on Missouri to latitude 45°.
433. *Euphorbia marginata*, Pursh. Very abundant to mountains.
434. *Euphorbia maculata*, Linn. Same as last.
435. *Euphorbia polygonifolia*, Linn. Along old roads. Upper Missouri.
436. *Ulmus fulva*, Michx. Abundant on the rich bottoms of Missouri to Big Sioux, and ceases to appear at the mouth of Niobrara river.
437. *Ulmus Americanus*, Linn. Along rivers and streams to mountains.
438. *Celtis occidentalis*, Linn. Abundant near to Niobrara river.

439. *Morus rubra*, Linn. Very abundant to mouth of Big Sioux; seen sparingly and of small growth to the mountains.
440. *Urtica gracilis*, Ait. Thickets and streams to Niobrara.
441. *Urtica Canadensis*, Linn. Same as preceding.
442. *Parietaria Pennsylvanica*, Muhl. Missouri and Yellowstone.
443. *Humulus lupulus*, Linn. Most abundant in the Upper Missouri country.
444. *Platanus occidentalis*, Linn. Abundant on the rich bottoms of Missouri and Kansas; but ceases to appear about one hundred miles above Council Bluffs.
445. *Juglans cinerea*, Linn. Big Sioux.
446. *Juglans nigra*, Linn. Does not extend above latitude 43°.
447. *Quercus tinctoria*, Bartram. Council Bluffs and Big Sioux.
448. *Quercus rubra* Linn. With preceding.
449. *Quercus macrocarpa*, Michx. Extends to mountains.
450. *Corylus Americana*, Walt. Abundant around Council Bluffs.
451. *Betula*. Black hills.
452. *Alnus*. Black hills.
453. *Populus tremuloides*, Michx. Black hills.
454. *Populus angustifolia*, Torr.
455. *Populus monilifera*, Ait. A large tree, constituting by far the greater portion of the timber along the valley of Missouri.
456. *Salix*. Several species.
457. *Pinus ponderosa*, Douglass. Black hills.
458. *Abies Douglassi*. Bad lands of the Judith.
459. *Juniperus Virginiana*, Linn. Along Missouri to mountains.
460. *Arum triphyllum*, Torr. Low ponds to Big Sioux.
461. *Arum Dracontium*, Schott. Found by Dr. Cooper in Kansas.
462. *Typha latifolia*, Linn. Mouth of Platte.
463. *Sparganium ramosum*, Hudson. Low places to Fort Pierre.
464. *Lemna*. Common in ponds on upper Missouri.
465. *Potamogeton natans*, Linn. White river valley.
466. *Potamogeton pectinatus*, Linn. In ponds. Bad Lands.
467. *Alisma plantago*, Linn. Common in ponds, upper Missouri.
468. *Sagittaria variabilis*, Engelmann. With preceding.
469. *Platanthera leucophea*, Nutt. Lower Platte.
470. *Spiranthes cernua*, Rich. Rich bottom prairies of Vermilion.
471. *Cypripedium pubescens*, Willd. Rocky banks to Big Sioux river.
472. *Cypripedium acaule*, Ait. With the preceding.
473. *Iris versicolor*, Linn. Lower Platte.
474. *Sisyrinchium anceps*, Linn. Bottom prairies to Fort Pierre.
475. *Hypoxis erecta*, Linn. Council Bluffs.
476. *Trillium sessile*, Willd. Extends to Big Sioux.
477. *Smilax herbacea*, Linn. Common. Mouth of Platte.
478. *Smilax rotundifolia*, Linn. Along Missouri to mouth of Platte.
479. *Smilacina stellata*, Desf. Very abundant to Niobrara, and occasionally seen to the mountains.
480. *Smilacina racemosa*, Desf. Council Bluffs.
481. *Polygonatum giganteum*, Dietrich. Council Bluffs.

482. *Allium Canadense*, Linn. Big Sioux.
 483. *Allium reticulatum*, Nutt. Abundant about Fort Pierre.
 484. *Allium stellatum*, Nutt. Platte and Loup Fork.
 485. *Lillium canadense*, Linn. Big Sioux to Fort Pierre.
 486. *Erythronium americanum*, Smith. Council Bluffs.
 487. *Erythronium albidum*, Nutt. Council Bluffs.
 488. *Yucca angustifolia*, Sims. From the mouth of Niobrara river to mountains; on sterile hills.
 489. *Streptopus amplexifolius*, D. C. Council Bluffs.
 490. *Melanthium Virginicum*, Linn. Big Sioux.
 491. *Juncus tenuis*, Willd. Abundant on bottoms of Missouri.
 491. *Juncus polycephalus*, Michx. Bad Lands, &c.
 493. *Tradescantia Virginica*, Linn. Sandy bottoms of Missouri and its tributaries; generally diffused.
 494. *Scirpus*. Many species.

The Carices of the botanical collection were submitted to the distinguished botanist, Professor Chester Dewey, of the University of Rochester, New York, who is unquestionably the best living Caricographer in our country. Even now, at the advanced age of seventy-four years, his enthusiasm in his favorite departments of Natural History continues unabated; and that his useful life may still be spared to us many years to come is the earnest desire of more than one young student of science who have been encouraged by his kind words and unselfish aid to seek a recognition in the scientific world. After a careful examination, the following catalogue and notes were received from Professor Dewey:

MY DEAR SIR: I enclose the list of all the Carices from Nebraska Territory that you placed in my hands for examination. The whole is a very interesting collection. I only wonder that, with your other objects of special attention, you were able to seize upon so many of these sedges; and yet I know they are only a small portion of the plants you have thus preserved. Wishing you all prosperity, and rejoicing in your perseverance and success,

I am truly yours,

C. DEWEY.

Dr. F. V. HAYDEN.

LIST OF NEBRASKA CARICES.

495. *Carex straminea*, Willd. Above Fort Pierre.
 var. *Minor*, Dew. Fort Pierre.
 496. *Carex cristata*, Schm. Little Sioux river.
 497. *Carex stipata*, Muhl. Little Sioux river.
 498. *Carex vulpinoidea*, Muhl. Common.
 499. *Carex mirabilis*, Dew. Common.
 500. *Carex cephaloidea*, Muhl. Near Fort Leavenworth.
 501. *Carex scirpoides*, Schk. Near Fort Leavenworth.
 502. *Carex festucacea*, Schk. Missouri, below Fort Pierre.
 503. *Carex Muhlenburghii*, Schk. Missouri, below Fort Pierre.

- *504. *Carex vulpina*, Linn. Large and fine. Missouri, below Fort Pierre.
505. *Carex tenera*, Dew. Missouri, below Fort Pierre.
506. *Carex hookeriana*, Dew. Missouri, below Fort Pierre.
507. *Carex rosea*, Schk. Southern Nebraska.
var. *radiata*, Dew. Southern Nebraska.
508. *Carex setacea*, Dew. Southern Nebraska.
509. *Carex teretiuscula*, Good. Southern Nebraska.
510. *Carex scoparia*, Schk. Common.
- †511. *Carex petasata*, Dew. Upper Missouri.
- †512. *Carex stenophylla*, Wahl. Upper Missouri.
513. *Carex festiva*,? Dew. (Too old to decide.) Near Fort Leavenworth.
- §514. *Carex Douglasii*, Boott. Before credited to arctic regions.
515. *Carex leporina*, Linn. Before credited to arctic regions.
516. *Carex obtusata*, Lily. Upper Missouri.
517. *Carex blanda*, Dew. Near Fort Clark.
518. *Carex anceps*, Schk. Near Fort Clark.
519. *Carex hystericina*, Wild. Eagle-nest creek.
520. *Carex grisea*, Wahl. Near Fort Leavenworth.
521. *Carex marginata*, Muhl. Missouri, near Fort Pierre.
522. *Carex arcata*, Boott. Missouri, near Fort Pierre.
523. *Carex crauci*, Dew. Missouri river.
524. *Carex steudelli*, Kth. Missouri river.
525. *Carex moodii*, Dew. Missouri river.
526. *Carex eburnea*, Boott. Missouri river.
527. *Carex lanuginosa*, Michx. Yellowstone, &c.
528. *Carex aristata*, K. Br. "Bad Lands."
var. *longo-lanceolata*, Dew. "Bad Lands."
529. *Carex riparia*, Good. Along Missouri.
530. *Carex trichocarpa*, Muhl. Along Missouri.
531. *Carex vesicaria*, Linn. Along Missouri.
532. *Carex longirostris*, Torr. Along Missouri.
533. *Carex filiformis*, Good. Eagle-nest creek.
534. *Carex acuta*, Linn. Eagle-nest creek.
535. *Carex vulgaris*, Fries. Eagle-nest creek.
536. *Carex stricta*, Lam. Eagle-nest creek.
537. *Carex strictior*, Dew. Eagle-nest creek.
538. *Carex recta*, Boott. Near Fort Pierre.
539. *Carex davisii*, Torr. Yellowstone river.
540. *Carex shortiana*, Dew. Along Missouri.

NOTES BY PROF. DEWEY.

* *C. vulpina*, Linn. First found in our country in Ohio, several years since, and cannot be confounded with *C. stipata*, Muhl. It seems to abound in Nebraska, large and fine.

† *C. petasata*, Dew. Collected first in Arctic America, and is abundant in Nebraska.

‡ *C. stenophylla*, Wahl. A northern carex in Europe, and first published by Dr. Boott among the "Carices of British North America" as common there, and is abundant in Nebraska.

§ *C. Douglassii*, Boott. First described in Dr. Boott's work just mentioned, but now found in Nebraska, which seems to have strayed, like *C. Richardsoni*, into our latitude.

- 541. *Carex ampullacea*, Good. Along Missouri.
- 542. *Carex monile*, Tuckerman. Along Missouri.
- 543. *Carex curta*, Good. Yellowstone river.
- 544. *Carex lacustris*, Willd.

The following species seem to be new :

- 545. *Carex Nebraskaensis*, Dew. Missouri river, near Fort Pierre.
- 546. *Carex Haydeni*, Dew. Missouri river, near Fort Pierre.
- 547. *Carex Meekii*, Dew. Yellowstone river.
- 548. *Carex levis-conica*, Dew. Yellowstone river.
- 549. *Zizania aquatica*, Linn. Along Missouri, wet ponds near Council Bluffs.
- 550. *Alopecurus geniculatus*, Linn. Near low wet spots on Missouri near Big Sioux and mouth of Loup Fork.
- 551. *Vilfa cuspidata*, Torr. Along Missouri river; also on high hills along White river.
- 552. *Sporobolus heterolepis*, Gray. Along Shyenne river in Missouri.
- 553. *Agrostis michauxiana*, Torr. Bottoms of Kansas, also on James and Shyenne rivers, upper Missouri.
- 554. *Agrostis cryptandra*, Torr. Banks of Little Sioux river.
- 555. *Muhlenbergia glomerata*, Linn. Abundant on prairies of upper Missouri; wood lands, &c.
- 556. *Calamagrostis Canadensis*, Beauv. Lower Missouri.
- 557. *Calamagrostis longifolia*, Henk. Sandy bottoms.
- 558. *Calamagrostis stricta*, Nutt. Along Missouri, moist places.
- 559. *Stipa spartea*, Linn. Prairies of upper Missouri.
- 560. *Stipa capillata*, Linn.
- 561. *Stipa membranacea*, Pursh. Sandy banks of Shyenne river.
- 562. *Aristida pallens*, Nutt. Sterile hills along Missouri; also on the Platte.
- 563. *Spartina cynosuroides*, Willd. Low situations on Missouri.
- 564. *Bouteloua oligostachya*, Torr. Upland prairies of Missouri.
- 565. *Sesleria dactyloides*, Nutt. This is one of the most abundant as well as useful grasses on the Upper Missouri. It grows in low matted tufts, covering the prairies oftentimes for many miles, and furnishing a most nutritious and palatable food for the buffalo, deer and other game; also for the horses of the Indian and voyageur.
- 566. *Festuca tenella*, Willd. Valley of the Missouri.
- 567. *Festuca nutans*, Willd. Along bottoms of Kansas.
- 568. *Kaleria cristata*, Linn.
- 569. *Eatonica Pennsylvanica*
- 570. *Poa pratensis*, Linn.
- 571. *Poa annua*, Linn. Sandy bottoms along Missouri.
- 572. *Poa nervata*, Willd. On the Kansas.
- 573. *Poa nemoralis*, Linn. Shady woods and ravines on Missouri.
- 574. *Arundo phragmites*. Abundant in moist places around Council Bluffs.
- 575. *Elymus Canadensis*, Linn. Wooded banks to mountains.

576. *Bruchmannia cruciformis*, Jacq. A beautiful grass, growing in low moist places. I have not seen it above Fort Pierre.
577. *Uniola stricta*, Torr. Hills of the Upper Missouri.
578. *Uniola paniculata*, Linn. Near Fort Leavenworth, K. T.
579. *Triticum repens*, Linn. Abundant along Missouri river.
580. *Hordeum pratense*. Above Missouri river.
581. *Hordeum pusillum*, Nutt. Above Missouri river.
582. *Hordeum jubatum*, Ait. Above Missouri river.
583. *Aira latifolia*. Above Missouri river.
584. *Aira elongata*. Above Missouri river.
585. *Ceratochloa grandiflora*.
586. *Cenchrus tribuloides*, Linn. Very common in Kansas, and seen on sand bottoms in the valley of Yellowstone.
587. *Andropogon scoparius*, Michx. Sandy bottoms of Missouri.
588. *Eragrostis poaoides*, Beauv. Along sandy bottoms, Lower Missouri.
589. *Monroa squarrosa*, Torr. in Whipple's Report. Great Bend of the Upper Missouri.
590. *Equisetum arvense*, Linn. Sandy bottoms along Missouri.
591. *Equisetum hyemale*, Linn. Covers large areas on sandy bottoms of Missouri and tributaries.
592. *Adiantum pedatum*, Linn. Council Bluffs.
593. *Botrychium Virginicum*, Swartz. Mouth of the Platte.

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